QUARTERLY JOURNAL FOR TEACHERS OF SCIENCE IN THE CATHOLIC HIGH SCHOOLS

The SCIENCE COUNSELOR

Volume VII ★ Number 1 ★ March, 1941

DUQUESNE
UNIVERSITY
PRESS

COORS
U.S.A.
COORS PORCELAIN COMPANY
GOLDEN, COLORADO
CHEMICAL AND SCIENTIFIC PORCELAIN WARE

The Science Counselor

"FOR BETTER SCIENCE TEACHING"

A QUARTERLY JOURNAL *of teaching methods and scientific information for teachers of science in the Catholic high schools. Published at Duquesne University, Pittsburgh, Pennsylvania, in March, June, September and December by*

THE DUQUESNE UNIVERSITY PRESS

Subscription Price: $1.00 per year; Canada, $1.25. Single copies of issues in the current year, 35c each.
Business and Editorial Offices at Duquesne University, 901 Vickroy Street, Pittsburgh, Pa.

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National Science Essay Awards

Once again Duquesne University has the pleasure of announcing the winners of its annual National Science Essay Contest.

This year essays were received from all parts of the country, essays excellent in quality and in numbers greater than ever before. Considering the preliminary contests that were conducted by the individual schools, more than 2,000 students took part in the contest.

To the winner of the single first prize is given a gold medal for permanent possession; to the winner's school a suitably engraved silver cup for one year's possession.

Because of the nearly equal merit of a number of entries the judges, nine members of the faculty of Duquesne University, found great difficulty in reaching a decision. After the winner had finally been selected the judges recommended that honorable mentions, all of equal merit, be given to the essays that were the last to be eliminated. This has been done. The winning essay will be published in our June number.

The winners:

FIRST PRIZE: Dona Gene Moberg, St. Joseph Academy, Yakima, Washington. Supervised by Sister Dorothy of Providence.

HONORABLE MENTIONS: All of equal merit.

Patricia Foster, Aurora, Ill. Name of school not given. Supervised by Sister M. Aida, O.S.F.

Mary Gloria Dempsey, High School of the Blessed Sacrament, New York City. Supervised by Sister Maria Caritas.

Genevieve Vaughan, Catholic Girls' High School, Los Angeles, California. Supervised by Sister Charlotte.

Mary Jane Rectenwald, Divine Providence Academy, Pittsburgh, Pa Supervised by Sister M. De la Salle.

Jean R. Doyle, St. Rosalia High School, Pittsburgh, Pa. Supervised by Sisters M. Josephine, I.H.M., and M. Macrena, I.H.M.

Alcohol and the Adolescent

• By C. Jelleff Carr, Ph. D. *(University of Maryland)*
DEPARTMENT OF PHARMACOLOGY, SCHOOL OF MEDICINE, UNIVERSITY OF MARYLAND, BALTIMORE

What is the truth about alcohol? How does it affect the user?

For years—sometimes under legal compulsion—teachers have pointed out to high school and college students the harmful effects of the use of alcoholic beverages. Often, we fear, the teaching has been influenced by an emotional rather than a truly scientific attitude. How much of what has commonly been taught is really true? Surely, enough that there is no need to exaggerate.

Here is an authoritative, clear and temperate statement by one who is highly qualified to write on this subject. Teachers should study it with care.

The drugs opium, caffeine, nicotine and alcohol are intimately connected with our civilization in a political, social and economic manner. Of all the drug products used by mankind these are of greatest interest. About each of them a malestrom of criticism or praise alternately circulates. A consideration of the effects of alcohol upon the normal human being is of prime importance both to the individual and to society. The high school student is fully as interested as the medical student in our knowledge of the action of these compounds in the body. What is the *truth* concerning alcohol, the drug which has been called the prop of an unstable civilization?

Pharmacologic Classification

Medicinally, ethyl alcohol is considered to be a drug substance, but not necessarily in the sense that the term "drug" is usually used by the lay individual, meaning a habit-forming narcotic. Pharmacologically, a drug may be any chemical substance introduced into the body. Likewise, contrary to common opinion, alcohol is not a stimulant. Alcohol is classified along with general anesthetics and barbituric acid compounds, as a depressant to the central nervous system.

Alcohol and Man

The average individual rarely, if ever, drinks pure ethyl alcohol as the laboratory worker understands the word "pure." He usually drinks alcohol as beer, wine, or stronger liquor (see Table). These beverages contain additional ingredients such as higher alcohols and esters.

One of the common errors in our knowledge of the influence of alcohol on man is our inability to define more accurately the factors of dosage. A moderate dose may be from 20 to 40 cc. of ethyl alcohol, depending upon the individual, and how the alcohol is consumed, and in what form. Equal doses of alcohol will produce different responses in different individuals. Hence, it is not unusual to find contradictory reactions of silence and noisiness, happiness and self pity.

ALCOHOLIC CONCENTRATION IN COMMON BEVERAGES

LIQUOR	PER CENT ETHYL ALCOHOL
Beer	1 — 3
Ale	4 — 9
Wine, German Mosel	7 — 14
Wine, French	6 — 10
Wine, American	10 — 17
Wine, Fortified (alcohol added)	16 — 23
Whiskey	47 — 53
Brandy	48 — 54
Rum	50
Gin	50
Liqueurs and Cordials	32 — 60

A fortified wine has alcohol added after the process of fermentation has stopped. Yeast fermentation is halted after a concentration of approximately 14 per cent alcohol is reached.

Another possible source of error in our knowledge is the point of view of the reporter. It has been said that the mellow poet who sings in laudatory terms of the grape can hardly be called an unprejudiced observer,—"contrawise the horrors of alcohol drinking as set forth by the fanatical prohibitionist are also apt to deviate from exact facts."

Alcohol in the Blood

Alcohol when consumed as a beverage is quickly absorbed into the blood stream. Because of its quick diffusibility it penetrates rapidly into all body tissues. The concentration of alcohol in the blood is of utmost importance, for the severity of the symptoms of intoxication varies with this concentration—the more alcohol absorbed into the blood stream the more marked the symptoms of intoxication. It is well known that the effects of alcohol are greatest when the beverage is consumed on an empty stomach. The before-dinner cocktail undoubtedly owes its popularity, and its hazards, to this fact. The presence of food delays the absorption of alcohol from the stomach, a very useful bit of information.

When alcohol is taken in moderate amounts it is practically all oxidized or burned in the body to carbon dioxide and water. Approximately 10 cc. per hour is

Continued on Page Twenty-seven

Research and Oblate Missions in the Canadian Arctic

• By Reverend F. Artheme Dutilly, O.M.I.
DEPARTMENT OF BIOLOGY, THE CATHOLIC UNIVERSITY OF AMERICA, WASHINGTON, D. C.

The "Naturalist of the Arctic Missions" has spent a number of years in the Arctic regions of North America studying the Eskimo and his environment. Working under great difficulties Father Dutilly and his co-workers have made important and extensive studies of Arctic flora and fauna, soils, rocks and minerals. Each year they have brought back great collections of materials for more detailed examination at their leisure.

In this paper Father Dutilly tells something of the results of his work on soils.

Uninformed readers will be glad to learn what kind of information is sought in such studies. All will be interested in what has been accomplished.

From the time of our designation as "Naturalist of the Missions" of the North American Arctic we have been enthusiastically at work without any consideration of the difficulties which had to be surmounted in order that we might acquire directly first-hand data about these regions which are so little known and so difficult of access.

Bishops Breynat, O. M. I., and Turquetil, O.M.I., have faithfully fulfilled the wish of the Pope that they should "concern themselves with the scientific side of their missions" in that they have kindly given us every encouragement and generously placed at our disposal the transportation facilities of the missions, including the modern boats, the "N. D. de Lourdes" and "M.F. Therese," as well as the aeroplane, "Santa Maria." This has enabled us to visit localities in the Arctic accessible to scarcely anyone else. Thus, in the course of the past eight years we were able to visit each of the Oblate mission stations in the far north from Alaska and Hearschell Island in the west, to Baffin Land in the east, so to complete about 75,000 miles of exploration. One hundred seventy-two localities have already been visited. The accompanying map shows their distribution.

From the outset we have had as our primary objective the study of the Eskimo and everything in his environment concerning him. For this reason we have been obliged to collect and study not only numerous specimens of Arctic flora and fauna but also soils, minerals, rocks, artifacts, etc.

The region of the Eskimo, more or less circumscribed by isotherm 10°C. (50°F.), is a part of a well-marked geological unit, the "Canadian Shield." The geology and geography of this area are sufficiently known to give us enough data for establishing some relation between their soils and flora and fauna on the one hand, and their inhabitants on the other. On account of the relative simplicity of these two factors in concert, the study of such relationship is more feasible here than possibly in any other part of the globe. Our work, whether upon soils, flora or fauna, has had to be conducted simultaneously because we could not obtain in one single expedition over so vast a territory the material necessary to accomplish at once the work on one or the other of these subjects. It was only after five years that we had in hand the materials necessary to undertake a somewhat complete and conclusive analysis of the soils of the Arctic.

We are glad to give our readers a sketch of our

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preliminary report on the Arctic soils with reference to edible and other plants.

The forty odd soils studied and analyzed are practically all *authigenous* soils, that is to say they are still in contact with the mother rock from which they have been formed by weathering. These soils have then incorporated in addition the debris of plants, more particularly such as comes from the lichens which cover the surrounding surface. We have obtained these soils upon the summits of each of the localities visited, which were often fairly high. However, some of them

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Father F. Artheme Dutilly, O.M.I., Naturalist of the Oblate Arctic Missions.

ARCTIC SOILS

SOILS OF CHURCHILL, MAN.

Lat. 58°40'N., Long. 94°15'W.
Silurian and Cambro-Silurian, Archaean, (West Fort).
Field No: MS 360727-I.
Lab. No: C 3471.

A. INORGANIC MATTERS:

1) Larger than 2mm.: 97.14%

"About half of this is limestone pebble: the other half is mixture of granites, schists, gneisses, etc. It would appear to be a sort of stream pebble bed from the heterogeneity of the mixture. Among the granite pebbles a buff-colored type predominated (about half orthoclase). Then there was a gray mica schist in which the feldspar seemed to be largely plagioclase (multiple twinning). I also found one piece of periodite (olivine rock). The content of the minerals should be about as follows:

Calcium carbonate	50%
Quartz	25%
Feldspar	15%
All else: biotite, hornblende, olivine, etc.	10%

Dr. Arthur R. Barwick, Dept. of Geology, C.U.A.

2) Less than 2 mm.: 2.86%

a) pH: 1° 6.82; 2° 6.75; Average: 6.7

b) **Mechanical Analysis**

U. S. Dept. Agriculture Classification

Diameter (mm.)	*Conventional Names*	*Percent*
2—1	Fine Gravel	15.3
1—0.5	Coarse sand	18.1
0.5—0.25	Medium sand	4.7
0.25—0.1	Fine sand	2.4
0.1—0.05	Very fine sand	1.7
0.05—0.002	Silt	18.7
Less than 0.002	Clay	6.6
Total (Calculated on basis of organic-free oven-dry sample)		
Organic matter by H_2O_2		31.0
Mineral matter dissolved by H_2O_2		1.5
Total (Calculated on basis of oven-dry sample)		100.0

Less than 0.005 mm.
Greater than 2.0

International Classification

Fraction	*Diameter (mm.)*	*Percent*
I	2.0—0.2	58.1
II	0.2—0.02	18.1
III	0.02—0.002	14.0
IV	Less than 0.002	9.8
Total (Calculated on basis of organic-free oven-dry sample)		100.0

Remarks: None

Analysis: T. M. S.
Date reported: May 13, 1938.

Note—Previous to January 1, 1938, 0.05—0.5 mm. was called silt; less than 0.005 mm. clay; and less than 0.002 mm. colloid.

B. ORGANIC MATTERS:

1) Field characteristics: "Dark brown organic fragments mixed with considerable sand and other mineral constituents." Dr. I. C. Feustel.

2) Partial analyses of peats or organic surface materials:

AIR DRY (1) Moisture	ASH Content	NITROGEN (2)	CARBON	CARBON NITROGEN Ratio
Percent 5.81	Percent 58.03	Percent 1.32	Percent 24.14	Percent 21.3

(1) Determinations by I. C. Feustel; (2) Determinations by Schimp.

Things of Science

• By Watson Davis, C. E. *(George Washington University)*
DIRECTOR, SCIENCE SERVICE, WASHINGTON, D. C.

An exciting new help for science teachers. You cannot afford to miss it.

So important do we feel this recently instituted service to be that we have withheld from this number material already set in type so that this announcement could be made.

The cost is ridiculously small considering the benefits to be gained.

You can't spend four dollars to better advantage.

Have you ever read about something new, such as a new fabric or a pebble fallen from the sky, and wished: "I wish I had a sample of that new thing!"

Actual things are so much more interesting than mere words or pictures.

It was to answer this sort of wish that **THINGS** of science, Science Service's latest non-profit service to make science more vivid and understandable, came into existence.

Actually it was editors of newspapers that received the first things of science. Searching for ways in which to dramatize and vivify the articles that Science Service was sending to newspapers, the device of sending samples of the things that were written about (when samples could be obtained and sent conveniently to the editors) was given a trial. The results were highly gratifying. Editors received these things, inspected them, and then decided if they were interesting enough that their readers ought to read the story and see the pictures.

After a few of these things were sent out in this way, the idea seemed so effective that it was felt that individuals, particularly science teachers, should not be ignored. And that was the way in which **THINGS** of science came into existence.

The new membership plan allows individuals and science classes and groups to look at, try out, feel and actually own unusual Things of Science. This novel idea will be continued for at least a year as the result of the enthusiastic response that greeted its experimental beginning.

Each month the members receive a scientific surprise package. The present Members of Things in Science received in February specimens of five novel fabrics, made of coal, air, salt, lime, glass, cat-tail (the plant not the animal), cellulose and milk. The January **THING** was a finger printing outfit. In December there was a striking box of candy that can not be purchased. It is candy made from whey, the scientific, modernized version of the milk product that little Miss Muffet ate with her curds, remember? This Christmas "Thing" was produced in cooperation with the Bureau of Dairy Industry of the U. S. Department of Agriculture.

The first "Thing" issued was an optics unit, demonstrating polarized light and other radiation phenomena.

The staff of Science Service is working on "Things" units on meteorites, taste, glass, plastics, heredity, odors, milk, metals, etc.

Because of non-profit operation, it has been possible to provide "Things" for only $4 for twelve monthly units. Provision is being made at the present time for only 5,000 members.

Actual materials and demonstration equipment contained in "Things" are accompanied by directions and instructions, together with the scientific details of the novel samples. Museum-style legends for use in displaying the various samples in each "Things" unit are also included.

"Things" units distributed early in 1941:

Fingerprint Unit.—Fingerprinting is in the news these days. One thinks of impressing an ink-smudged finger on paper—a messy business. Members will receive an inkless fingerprinting outfit with material good for many impressions. There will be a purse fingerprint card that may sometime be useful in cashing a check, and two official complete fingerprint record docu-

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"Things" for January, 1941.

Science Fusion $\xrightarrow{\text{causes}}$ Mental Confusion

• By Sherman R. Wilson
NORTHWESTERN HIGH SCHOOL, DETROIT, MICHIGAN.

College domination of the content of high school courses, the doctrine of formal discipline, and the demand for functional science all are said to have played a part in causing the state of confusion that the writer finds in secondary school science.

After tracing the history of the fusion of science courses, Professor Wilson states his belief that an integrated physical science course of the type that has commonly been given cannot satisfactorily replace the traditional courses in physics and chemistry for all students.

Recognizing the difficulties of the situation, the Detroit School System has begun to do something about it. Mr. Wilson describes the plan.

This paper should be read in connection with that of Mr. Robert H. Carleton in this number.

●

Teachers of chemistry admit that there are a number of things wrong with chemistry. Judging from the many articles we seen in our current journals, the plight of physics is even worse. Something is radically wrong. High school science in some parts of the country is sick, afflicted with a mental disorder which is somewhat hysterical in its nature. Perhaps high school science is suffering from a mild case of *psychoneurosis*. At any rate I shall pose as a psychiatrist and try to diagnose the case. The approved procedure is, I believe, first to discover the cause, then to note the developments, and, finally, to suggest a cure.

After studying the history of science teaching, I have come to the conclusion that the trouble started shortly after the turn of the century. Previous to this time, the chief aim of the high schools was to prepare students for college. The subject matter in physics, chemistry, and other high school sciences was controlled by college-entrance boards and, in fact, most of the textbooks were written by college professors. Then came the revolt. At first only a few schools were bold enough to raise the cry for freedom, shouting, "Why should we let those college professors tell *us* what to do?" Perhaps this uprising was necessary, but, as is frequently the case, the period of adjustment has been one of disorder and confusion.

Another cause which has contributed to the present sad mental state of our patient was the attempt to overthrow the "doctrine of formal discipline." This doctrine, as you know, is founded on a belief in the transfer of training. The proponents of this theory claim that any ability, such as the use of the scientific method, can be transferred from one field to another. Psychologists tell us that this is true only to a limited extent; that, for the transfer to be successful, the field must be similar. For example, a chemist may do a very poor job of applying the scientific method to a problem in economics or sociology.

Before this limiting feature was disclosed, many teachers believed that *discipline* was the chief aim of all science teaching, and that subject matter was of little importance. When the fact that the old methods were not perfect began to be recognized, there arose a demand for "functional" science, for subject matter that would be useful rather than abstract. But please do not misunderstand me. I am not arguing for or against the domination of the colleges or the doctrine of formal discipline. I am simply stating that the struggle to overthrow these forces has acted as a contributing factor to the present state of confusion through which science in our secondary schools is now passing.

How has this condition developed? Fused-science courses have played an important part. The first step in this fusion process was taken about 1900 to 1905, when general science and biology were started. In the beginning, these sciences were formed by simply welding the older sciences together end to end. Biology consisted of a half-year of botany followed by a semester of zoology; and, in general science, some schools tried to teach all of the natural sciences one after the other.

In the second step we see an attempt to fuse two or more sciences into one mass and call it a unit. In biology, flowers, grasshoppers, and elephants may all be mixed up and served together; and in some senior high school science textbooks we find astronomy, bacteriology, chemistry, and physics fused (or should I say confused?) all in a single chapter.

As a third factor contributing to this disorder, I call your attention to certain widely advertised fused-science courses that are being offered for the consumer. In some of these consumer courses much emphasis is placed on such problems as how to buy a refrigerator, but, as a rule, scientific principles are considered to be of little importance.

The latest development is an attempt to fuse all the subjects in the curriculum — English, mathematics, social studies, and the natural sciences — all into one unit. The advocates of this method call this scrambling process *integration*, and refer to these so-called units as *core-subjects*. This trend has spread from New York to California, or vice versa, and, in some schools, this attempt at fusion is causing much confusion.

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Physical Science for General Education. *Part I*

● By Robert H. Carleton
CHAIRMAN, SCIENCE DEPARTMENT, SENIOR AND JUNIOR HIGH SCHOOL, SUMMIT, N. J.

Like many others, Professor Carleton has been giving careful study to the question of integrated science courses. The Summit School System has developed a philosophy and planned a course of action based upon it that will interest those who are concerned in this modern trend.

Mr. Carleton describes the new plan and tells what it is designed to accomplish. In our next number he will show definitely how the plan operates. Readers will want to compare the ideas expressed in this paper with those of Professor Wilson given in another article in this issue.

Professor Carleton is co-author with F. O. Kruh and F. F. Carpenter of a new high school textbook, "Modern-Life Chemistry," published recently by the J. B. Lippincott Company. This book will be reviewed in an early number.

●

There is widespread recognition of the need for a revamped and more functional science curriculum for the senior high school. Alert teachers everywhere have come face to face with the same problem: namely, What kind of science shall we offer, particularly for students of somewhat limited ability and of non-academic interests, who probably won't go on to college? Should we strive for some kind of fused or generalized science; or should we retain the special science boundaries and merely modify the courses within them to meet the new demands; or should we give a course which surveys several of the special science fields?

In spite of the fact that there is still considerable debate regarding the merits of each of these possibilities, a definite pattern of revision seems to be crystallizing. Integration, fusion, and generalization of science are in the air; the trend in this direction is growing with accelerated motion. Junior high school science has long since gone "general," while junior college science has been "orientation" or "survey" science almost from its beginning. During the past two or three years, the last stronghold of the special sciences — the senior high school — has swung over to generalized science with dramatic rapidity.

Thousands of non-college preparatory students have thus been spared the ordeal of studying valence, balancing chemical equations, learning the details of sulfuric acid manufacture, probing into the inner structures of the earthworm, classifying plants and animals in half a dozen different ways, determining the value of g, and verifying the fixed points of the thermometer. (Ah, me! the hours I spent with thee!) Instead, they have been studying the kind of science which promises to have definite functional values for them in their present and future non-specialized activities as citizens of our great democracy.

We have come to grips with this revision problem in Summit High School, and in this article and in the one to follow, I shall describe our present solution and explain the underlying philosophy which is our constant guide to the selection and organization of materials of instruction. Perhaps our experience will be of some help to others who contemplate revision of their science offerings.

We have set up two pathways in science through the senior high school. Our college preparatory people take biology in the 10th year, follow with chemistry in the 11th year, and take physics in the 12th year. We try to teach these courses humanely. We try to make them interesting, challenging, and worthwhile. And when we're through we expect our students to know and understand what biology, chemistry, and physics really are and how they serve mankind. Such courses meet the needs of college preparatory students, and they meet with the enthusiastic approval of students and parents alike.

The alternative courses for the non-college students are biological science (10th year) and physical science (11th year). In response to student demand, a 12th year course, as yet unnamed, is now being worked out. These courses have been developed as answers to the question, What science will it profit the average person to know? In other words, What *functional* knowledges and experiences can we organize into interesting and worthwhile courses for the sake of the general education of these students? These alternative courses are not special science courses purged of their more abstract and technical details; nor do they consist of a series of units or sections devoted to surveying the special sciences; neither are they a hodge-podge of science thrown together simply for the sake of fusion. They are courses which deal primarily with *problems of human living which require us to make adjustments to the forces and materials of our environment.*

These adjustments may range from turning on the faucet for a drink of water to reading about the latest research on "heavy water"; from caring for a potted plant to growing plants without soil; from protecting ourselves against sunburn to using X-rays.

The adjustments we make may be simple or complex, but the need for making them is an essential factor in all living, for to live is to make adjustments. Man is constantly making adjustments to his physical environment, to his biological environment, to his social en-

vironment, and to himself. Whatever science content and activities are deemed to have high potential value in promoting more effective human adjustments to our physical and biological environments—and to some extent in the other two areas—may be included in the course; all else must go. In other words, nothing is retained simply because it is "good science."

Thus we come to the heart and soul of our science curriculum, our basic philosophy. Our philosophy and our beliefs, more than anything else, influence what we teach and how we teach it. Of the many suggested philosophies and points of view set forth in the writings of fore-thinkers in science education, the "adjustment philosophy" of Professor C. J. Pieper of New York University seemed to serve us best in developing these courses. As explained in the *Thirty-First Yearbook*, and as taught and practiced by him and his associates, it provides a modern, practical, and sound basis on which to develop a program of science instruction. Several assumptions underlie the philosophy of science for human adjustment:

1. Our environment includes a number of forces and materials with which man is constantly interacting and which require him to make adjustments to them (that is, to *do* something about them).

2. These problems of human living may require adjustments of us individually or collectively; the adjustments may be intellectual or practical.

3. For the purpose of general education, "science" must be construed to consist of *knowledges* concerning the forces and materials of our environment, of scientific *problem-solving techniques* applicable to adjustment problems, and of scientific *attitudes* (including appreciations) regarding the problems of living.

4. To solve these problems of human adjustment in an intelligent and effective manner requires the use of conscious techniques of scientific problem-solving and the application of a broad knowledge of the field of science, both being governed by the accepted scientific attitudes.

5. The knowledges which contribute to an understanding of the significance to us of the forces and materials of our environment usually cut across man-made boundaries and come from several of the specialized fields of science. Seldom are they confined to a single one.

6. The real problems of adjustment arise from the felt needs and desires of daily human living. These needs and desires, therefore, are the purposes served by "science designed for better human adjustment."

Among the needs and desires which give real purpose and practical value to science courses developed on this basis are the following: to provide materials necessary to life (food, air, water, etc.); to maintain better health; to secure greater comfort, convenience, and safety; to develop wiser consumership and to increase economy; to engage in scientific leisure-time activities; to promote more effective conservation; to participate more fully in social and economic adjustment in a democracy; to understand "the science world picture"; and to substitute action based on critical thinking for action based on intolerance, prejudices, traditions, superstitions, and misconceptions. These are the criteria by which to judge whether or not certain materials and activities go into the course. If the proposed materials and activities have high potential value in helping us to make better adjustments along these lines so that we may live a more liberal, practical, and cultured life, they are retained; otherwise, they are rejected at least from the core of the course.

The adjustment philosophy and its underlying assumptions not only influence the selection of materials and activities of the course, they also suggest a plan of organization, the instructional techniques, and the type of evaluation program for the course. Our courses in Summit are organized as a series of units (areas of adjustment) which are in turn broken down into a small number of problems to be solved or investigated. These problems are treated as nearly as practicable by the essential steps in scientific problem-solving. There are unit and problem previews or preliminary discussions, suggested hypotheses, and suggested methods of testing the hypotheses. By means of demonstrations, motion pictures, text references, additional readings, and organizational activities, a command and understanding of the basic facts, concepts, principles, and broad generalizations are developed. These outcomes are, of course, tied back to the original problem by discussions and various other means. Students are encouraged to do individual investigational work (we don't call it research) and undertake various types of projects.

In connection with the instructional procedures, we have accepted the following set of beliefs or "tenets of faith" for teaching science; they are, of course, subject to constant evaluation and revision:

1. The development of the scientific attitude is one of the most significant things that has ever happened to the human race.

2. John Dewey: "The future of our civilization depends upon the widening spread and deepening hold of the scientific habit of mind; . . . the problem of problems in our education is therefore to discover how to mature and make effective this scientific habit. . . . Scientific thinking is the only method of thinking that has proved fruitful in any subject."

3. Understanding of generalizations and principles should be the outcomes of the study of scientific facts. These outcomes are not the necessary concomitants of the study of such facts, however.

4. Generalizations should be developed from experiences. The statement of a basic principle or a broad generalization by the teacher or textbook does not constitute learning or understanding of such a principle.

5. If a principle is to become functional, it should be used in a number of situations other than the one in which it was developed.

6. Students in the classroom have not learned very much about problem-solving techniques, chiefly because teachers have assumed that by teaching the facts, students will develop their problem-solving abilities as a natural and necessary by-product.

7. The amount of subject matter covered per year will have to be less if we agree that the

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Some Phototropism Experiments

● By Walter A. Thurber
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Even if you are not a teacher of biology you should read this paper.

Research, real research, that high school students may profitably undertake! Interesting experiments the results of which even the teacher does not know beforehand. Learning that negative as well as positive data are important. The dangers of unwarranted generalizations. All these enter into this helpful article which outlines worthwhile pupil experiments dealing with the behavior of simple organisms.

This paper suggests at least one solution for some of the conscientious biology teacher's most pressing problems.

●

It is to be feared that most of us use in our classes only experiments that "work," in other words, that yield positive data. It seems very possible that unscientific concepts are developed by observing experiments that always behave as expected.

In the first place, pupils may come to consider negative data worthless; certainly they are not given practice in using negative data. Again, because of the premium placed upon positive data, pupils are tempted to make their experiments agree with the expected results, thus developing a serious form of scientific dishonesty. Even teachers have been known to "doctor up" their demonstrations.

Another danger lies in leading pupils to believe that all the simple things in science are known; that the only fields left for research are those dealing with cancer-cure and radioactivity. Certainly, such a concept is far from the truth.

The error lies in making our experiments deal with principles, rather than things. We desire so much to have our pupils verbalize generalities that we forget the main purpose of our teaching. And so we give a single experiment that will "work," and on this slim foundation we erect a sweeping generalization. On this subject of unwarranted generalization, too much could not be said.

The study of the behavior of simple organisms offers some excellent material for pupil experimentation in a high school biology course. Not the least of the advantages is due to the fact that teachers themselves are unable to be certain of the outcomes. Equipment is simple, truly a virtue. Finally, each pupil has an opportunity for really scientific research, often in virgin fields, unhampered by need for extensive training and elaborate equipment.

Literally hundreds of simple experiments are possible. Plants, both land or water, fish, frogs and insects, have (or fail to have) certain responses to such stimuli as light, heat, sound, touch, electricity, chemicals, gravity. Some of these responses are undoubtedly closely connected with the success or failure of a species.

Experiments testing one type of response are given below. The required apparatus, the "phototropism box" shown in the diagram, is a variation on a suggestion given by Dr. E. Laurence Palmer in the *Cornell Rural School Leaflet* for January, 1933. The work was carried out by students at the New Hampshire Nature Camp.

A shoebox is fitted with a partition as shown. This partition may be held in place with brass paper clips. The open top of the box and the two windows are covered with cellophane held on with adhesive tape.

A desirable refinement is a door in the side to facilitate putting an organism inside. Adhesive tape makes good hinges. In a similar manner shutters for the windows may be attached.

Suppose that the problem is to discover the reaction of a grasshopper to light. The grasshopper is inserted, the lid put in place, one window is covered, and the other window turned toward the light. At the end of a certain time interval, say five minutes, the lid is removed to discover the location of the grasshopper.

Obviously, one trial would not be sufficient, so another is made. A certain number of trials are carried out with the grasshopper always in the light compartment at the beginning; then a certain number of trials with the grasshopper always in the dark compartment at the beginning.

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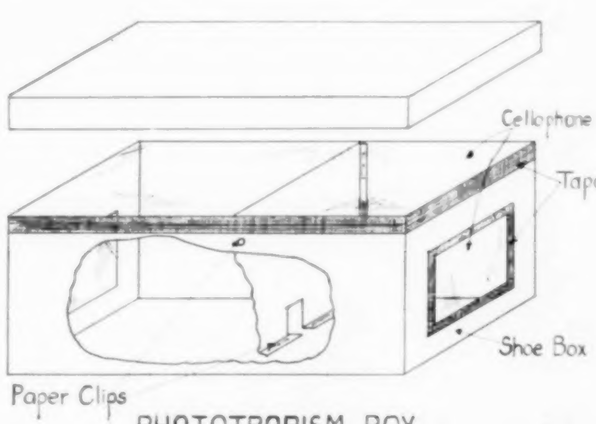


PHOTOTROPISM BOX

Confessions of a Gadgeteer

• **By Richard M. Sutton, Ph.D.** *(California Institute of Technology)*
DEPARTMENT OF PHYSICS, HAVERFORD COLLEGE, HAVERFORD, PA.

This is an important paper, written by the President (1940) of the American Association of Physics Teachers,—an enthusiastic teacher who knows how to teach and one to whom "gadgets speak a language of their own."

He believes that "If the instructor will try constantly to find new ways to illustrate old principles, he will never be bored with his job and his students will not be bored by his teaching." We have an idea that there is little inattention in Dr. Sutton's classes.

The delightful introduction in which the writer philosophizes about gadgets and gadgeteers may well cause many teachers to examine their pedagogical consciences. The article as a whole should encourage them to put their own special teaching ideas into concrete form.

Dr. Sutton is Editor of "Demonstration Experiments in Physics", an indispensable teaching help. This book is reviewed in another place in this number.

I love gadgets!

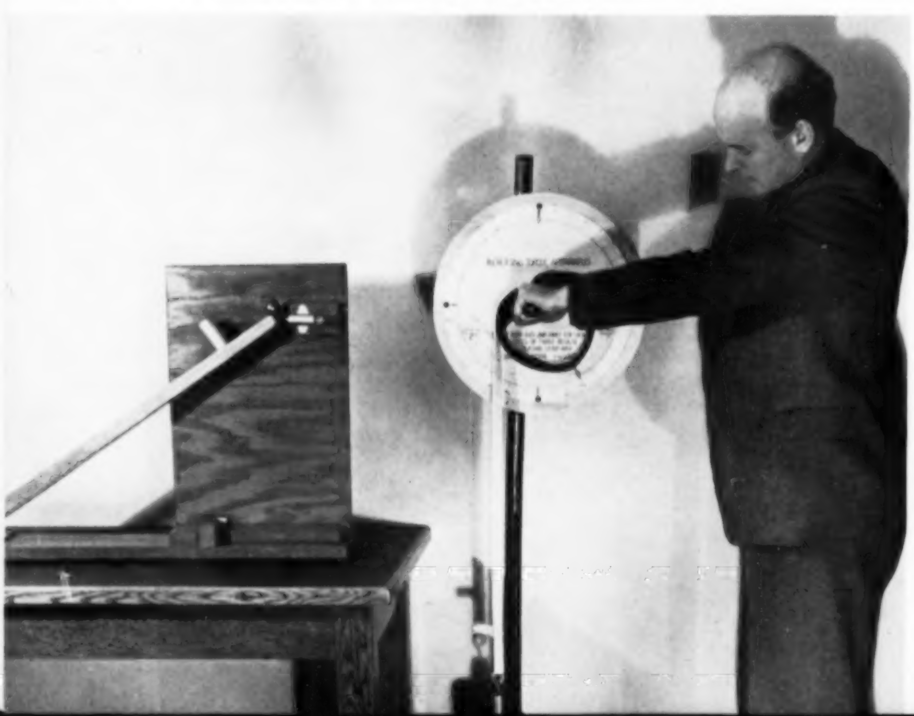
There is something about any trick device that appeals to me, and I marvel at the human ingenuity that has prompted the invention in this country of more than two million patented devices in the last century, not to mention the many million more that have not been patented. Every new combination of levers, gears, and cranks, and every new arrangement of an electrical circuit or an optical system shows that there is imagination active in the world, and that men are continually seeking new and better ways of doing things. This constant flow of ideas, some great, some trivial, is evidence that Man is learning to use some of the creative power with which he is endowed. It is easy to believe, in view of past performance and the general acceleration of inventions, that still greater things are yet to be invented than have already appeared.

But, as a physicist and as a teacher of physics, I feel that gadgets play an important part in the progress of science. It frequently happens that the value of a piece of research work is to be found fully as much in the concoction of some new tool or contrivance as in the particular "readings" that the observer has made upon some new and obscure "effect"; for the new device is likely to become useful in fields far removed from the one for which it was specifically designed.

Consider, for example, how fruitful in modern research have been two comparatively simple inventions, gadgets *par excellence:* the Wilson Cloud Chamber, originally designed for studying condensation phenomena; and the Geiger-Muller Counter, first designed for counting alpha particles. Each was created to meet the needs of a particular research problem, but each has outstripped in usefulness the fondest hopes or expectations of its originator. And when both devices are coupled together, there results one of the most powerful means of attack on many problems in modern physics. Again we stand amazed at the simple inventiveness which lies behind the Cyclotron which was, twelve years ago, but a wild idea in the head of a young man at Yale. Despite its enormous weight and complexity, the cyclotron is (to me) still a gadget, and I admire its functioning and the ingenuity of its inventor.

What is a gadget? Not just a combination of levers, gears, electrical parts, or lenses, but the embodiment of a spark of originality which, coupled with a lot of inert pieces of apparatus, appears as something which almost breathes the human spirit that created it. And when anyone succeeds in putting into material form what was previously only an idea in his head, he becomes thereby a *Gadgeteer*, although some might prefer the name "inventor."

FIG. 1.
RIGHT. Torque increases uniformly with angle through which handle is twisted.
LEFT. The Falling Chimney. The cup catches the ball.



In the teaching of physics, gadgets play an important part. All the simple but delightful devices used for illustrating physical principles are made just to help the teacher convey his subject to his students. What can be better, when discussing a new or difficult principle, than to "bring in a sample"? I once knew a teacher who declared the best way to learn about a block and tackle was to *use* a block and tackle. Such a simple and homely philosophy of teaching is sometimes lost to view. How often we find ourselves trying to teach students who have never seen or felt or heard or smelled what we are talking about!

Physics, perhaps more than any other natural science, is based upon observation from experiment, and its findings are subject, for the most part, to experimental illustration and confirmation; yet the more refined our ideas become, the more we are in danger of departing from factual, observational information in our teaching. In attempting to impart to our students an understanding of modern developments in science, we are prone to build an elaborate superstructure of ideas upon a flimsy foundation of observation and experience.

Gadgets speak a language of their own. I am convinced that the liberal use of experiments shown with simple, even homemade, apparatus is an effective way to drive home the fundamentals of physics. One experiment properly presented and punctuated with suitable remarks is worth more than a lot of talk. Laboratory experiments are useful as a means of acquainting a student with careful measurement and the analysis of results, but the number of such experiments which a student can perform in a year is very small compared with the number of qualitative experiments that can be shown to demonstrate principles as they are met. I know of no better way to enliven the teaching of physics, not only in its introductory aspects but in its more advanced phases as well, than to include plenty of experiments. The student should be kept constantly aware of the fact that he is dealing with ideas based upon experimental observations which he himself can make, given suitable means; and I wish I might impress upon teachers of physics that "suitable means" are frequently within easy reach. If the instructor will try constantly to find new ways to illustrate old principles, he will never be bored with his job and his students will not be bored by his teaching.

The creation of a new gadget is an intoxicating experience. The degree of intoxication is not necessarily measured by the world-shaking importance of its discovery, but rather by the intellectual exhilaration which comes from finding something new or unique. One can then better appreciate the love which men like Edison and Faraday had for their work, preferring above all else to be at work in their laboratories engaged in the process of creation. Faraday is quoted as saying, when asked why he didn't try to profit by his discoveries, "I am more interested in the discovery of new truths than in enhancing the powers of those already discovered." The world is the richer for his attitude; and although Faraday was never wealthy, he was one of the most contented of men because he chose the life of an investigator. He believed, to quote his biographer Tyndall, that "from every experiment issues a kind of radiation, luminous in different degrees to different minds; and he hardly trusted himself to reason upon an experiment that he had not seen." Too frequently, we expect our students to reason intelligently from experiments that they have never seen.

To many students the equations and formulas of physics are forbidding. Now, physics can be taught without much mathematics, but it cannot be taught well without a lot of straight thinking; and the minute a student begins to think straight, he is thinking in terms that are essentially mathematical. He must master clear-cut definitions, for most definitions are simply word statements of important relationships that can be written in equation form, and until he knows what he is talking about, his thinking is bound to be hazy. Each of the simple equations of elementary physics, and most of them have only three or four symbols, is a statement of a relationship that is subject to illustration in various ways. And there is no better way of putting an equation to work than by making it the basis of an experiment. Gadgets that illustrate equations are helpful, for the variables of the equation (such as masses, forces, currents, etc.) may then become the variable elements in a piece of apparatus in an actual experiment. Every equation that the student meets should be stretched, twisted, turned, and generally "manhandled" (within the rules of algebra) to make it divulge what it is good for! I try to get my students to see these equations not just as formulas to be memorized, but as flexible relationships that can be put to use in new situations. I try to develop in them the ability to turn any equation inside out and around until it presents a convenient "handle."

Many of the gadgets that have demanded my attention are those that have a mathematical slant, although they arise from physical considerations. Frequently, the chief joy in working with a new gadget is found in wrestling with the mathematics involved, or in making the gadget conform to certain pre-assigned conditions. In concocting gadgets I find myself repeatedly stumbling into pretty problems of algebra, geometry, trigonometry, and calculus. Even the most innocent-looking gadget may call for the solution of a differential equation or an elliptic integral. But, although it is necessary in some cases to call upon mathematical tools that have become rusty, I am amazed by what can be accomplished with simple algebra, geometry, and trigonometry, with the accent on geometry.

The gadgets that one has evolved seem to "belong" almost like children, for each has a life history of its own. However, few but the parents are ever interested in all the details of such life histories, so I will spare my readers by confiding only a brief outline of several of these gadgets which have more or less immediate application to the teaching of physics. The first may be beyond the understanding of students of elementary physics, but it never fails to excite interest and amusement. Behind it lies a good deal of analysis which is worthy of the attention of more advanced students.

For want of a better name, I call it "The Falling Chimney" because the idea of it arose from consideration of the question, "Why does a tall chimney buckle *backward* as it falls?"[1]

The problem involves the dynamics of a column which, in falling, rotates about an axis at its base. All parts beyond its center of oscillation are made to accelerate faster than they want to go, hence they have a kinetic reaction "backward." Now, it occurred to me that at some angle the vertical component of the acceleration at the end of the column becomes greater than the acceleration of gravity, and a simple analysis shows that this is true for all angles of inclination of the column for which $\cos^2 \theta \geqslant r/l$ *(Fig. 1)* where r is the distance from axis to center of oscillation P, and l is the length of the column. In the actual apparatus, l is a stick of length about 60 cm. Consequently, by poising a ball on the end of the stick when it is set at the maximum permissible angle, and then suddenly allowing the stick to drop by knocking out a prop from beneath it, the stick *falls away from the ball* even though the ball is freely falling. The ball plummets into a light cup which is carried down by the stick so that it arrives under the spot where the ball *was* when the motion started. The cup catches the ball, showing that the end of the stick falls several inches farther than the ball. The motion is quick and deceptive, for it looks as if the ball jumps up and over into the cup. But if a "map" of the arrangement is placed behind the gadget, it is easy to follow the motion and see that the ball descends along a vertical line and that the wood of the stick falls faster than the steel of the ball! Perhaps both Aristotle and Galileo would find something to think about if they should see this gadget.

In approaching any physical principle, I try to reduce it to its simplest terms. The apparatus illustrated in Fig. 2 was designed to demonstrate the principles of torque, particularly to emphasize the meaning of lever-arm, which students sometimes find hard to understand. The device consists of a piece of broomstick into which is set a 6mm. steel rod 1 meter long extending at right angles to the broomstick handle. A movable clamp with a set-screw holds a one-kilogram weight; thus the apparatus offers a ready means for changing the torque produced by the weight simply by moving the weight farther from the handle.

Let a student try to hold the steel rod horizontal by grasping the broomstick in one hand. It is easy when the weight is near the hand, but it becomes impossible when the weight is far from the hand, and he may do well to hold the rod horizontal with *two* hands when the weight is one meter from his hands. However, lowering the weight without changing its distance from the hands shows that the torque is decreased because of decrease of effective lever arm (the horizontal projection of the steel rod); or the rod may be held horizontally with one hand even with the weight at its outer end if the broomstick is but turned into a vertical position so as to give the hand a longer lever arm and a more advantageous grip. If there is any virtue in learning physics through the *muscles*, I believe that this simple gadget should be in every laboratory. It does its own teaching!

To illustrate the sort of mathematical difficulties which one may encounter by an innocent modification of a simple gadget like the last one, consider the following: It is evident that the torque (Q) which one must apply to the broomstick is, for a fixed distance (d) of weight (W), proportional to the sine of the angle which the rod makes with the vertical, or $Q = W\,d \sin \theta$. I wanted to make the torque dependent upon θ and not $\sin \theta$, that is, to make $Q = k\theta$.

Figure 1 (photograph) shows the gadget in operation. An eight pound weight hangs from a tape whose distance from the axis is always proportional to the angle through which the handle has been turned. A calibrated scale gives the actual torque exerted for any position of the pointer. The spiral which makes this possible is the curve B of Figure 3 which is found by drawing the "respectable" spiral A for which $r = k\,\theta$; and then, at each point P of spiral A, drawing a tangent QP to the Circle C P C′ whose center is at the origin. The envelope of these tangents is the desired spiral B whose equation, found from its parametric equations, is $r' = k\sqrt{\theta^2 + 1}$, where θ refers to the angle of the original spiral and is not, unfortunately, the angle made by r' with the Y-axis. This angle, ϕ, is related to θ by the equation: $\phi = \theta - \tan^{-1}\theta$. Now, I have never paid much attention to "springless" scales before, and the joy of turning up this spiral curve with its special properties was not greatly diminished by the realization that I had perhaps done nothing but re-invent the springless scales several years too late.

A continuing interest over several years has been the investigation of liquid manometers and their dynamic uses for the measurement of acceleration.[2] From this study have come several devices for use in the physics lecture room. I shall describe but two, the linear acceleration meter and a barometer of special design which gives large variations of level with changes of atmospheric pressure.

Acceleration plays an important role in mechanics, and it has seemed desirable to make accelerations immediately visible to students during the progress of an accelerated motion. To that end, a manometer is mounted on a small car that can be pulled across the lecture desk by pulley and weight. (Fig. 4). Mercury fills the lower portion of the manometer A, whose horizontal length is 25 cm; above the mercury in one vertical arm there is colored water which extends into a tube of smaller bore B, than that containing the mercury, thus making a device far more sensitive than would be a simple U-tube filled only with mercury or water. When the car carrying the manometer is accelerated, the water level shows direct evidence of the magnitude of linear acceleration which persists so long as the acceleration lasts. But when the car is slowed down by friction, it shows negative acceleration which lasts right up to the last instant of the motion. By utilizing the inertia of the mercury and making it throw most of the hydrostatic pressure difference into

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Fig. 3

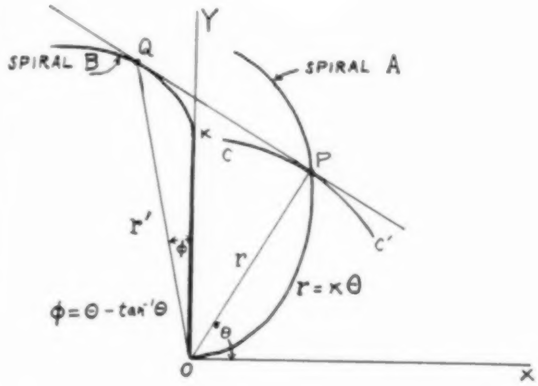


Fig. 8

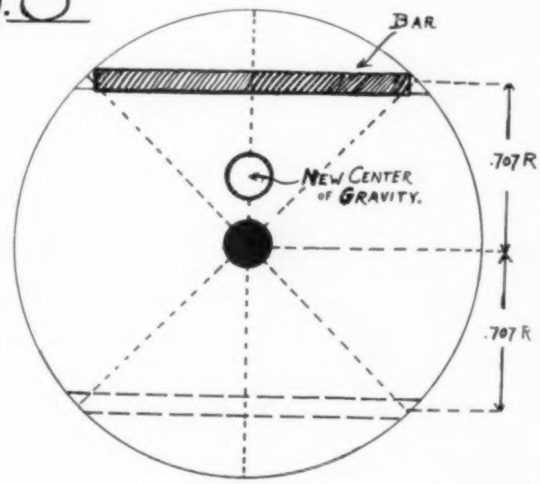


Fig. 2.

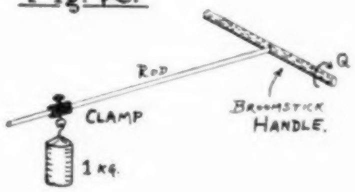


Fig. 5

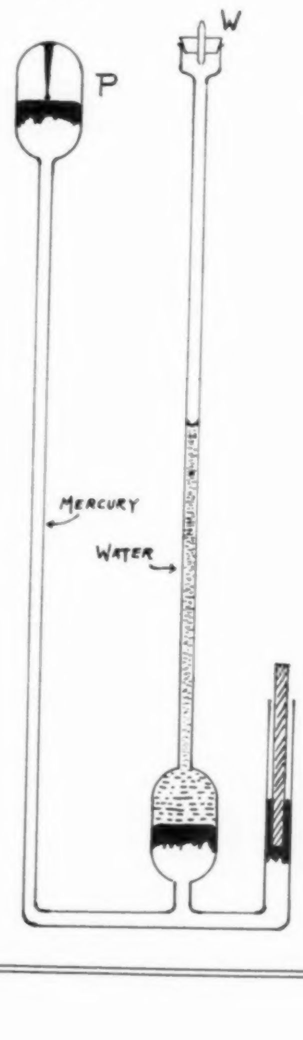


Fig. 6

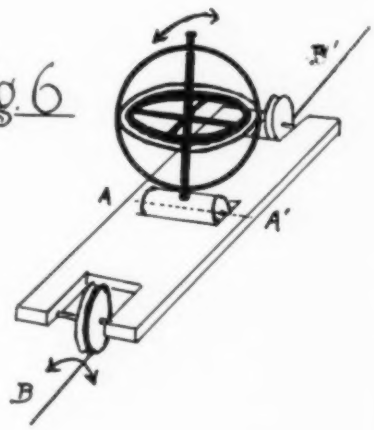
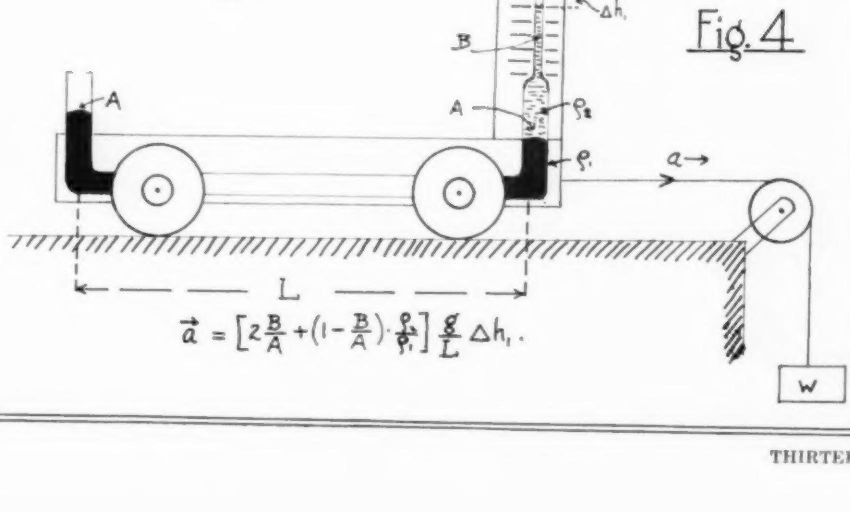


Fig. 7

Fig. 4



$$\vec{a} = \left[2\frac{B}{A} + \left(1-\frac{B}{A}\right)\cdot\frac{\rho_2}{\rho_1}\right]\frac{g}{L}\Delta h_1 .$$

The Use of the Word *Mole* in the Teaching of High-School Chemistry

• By Brother I. Leo, F. S. C., Ph. D. *(Catholic University)*
SAINT MARY'S COLLEGE, WINONA, MINNESOTA

This article contains a message for many teachers of chemistry.

The writer justifies the use of the word "mole" in high schools because the concept does not introduce anything new, its use in the solution of problems will substitute logical reasoning and arithmetical procedure for mechanical steps and the algebraic method, and the comprehension of the meaning of the word necessitates a better understanding of the significance of equations and leads to facility in balancing them.

Brother I. Leo is at present temporarily located at the Christian Brothers College, Memphis, Tenn.

The purpose of this paper is twofold: first, to discuss reasons for the adoption of the word "mole" in high-school chemistry courses; second, to show how the concept of mole can be applied at the high-school level.

Reasons for Adoption of the Word

A mole* of a substance is as many grams of it as there are units in its molecular weight. Since this definition is the same as that of gram-molecular weight, an expression used in all high-school textbooks and courses, the concept of mole is not a new idea for the secondary course in chemistry. Because some authors(1) refer to moles of monatomic elements, the unit commonly designated as the gram-atomic weight, the significance of mole might be a little more comprehensive than that of gram-molecular weight. This extension, however, is neither general nor confusing. Deming's text(2), in which the expression gram-atom is used instead of gram-atomic weight, is typical of many college books. However, since the atom and the molecule of a monatomic element are identical†, it would perhaps be less confusing to call both gram-molecular and gram-atomic weights "moles" than to have the mole distinct from the gram-atom. If students comprehend this broader concept of mole, then the instructor would have reason to believe that pupils understand that the atoms and molecules of monatomic elements are identical, at least as these words are used when applied to chemical equations.

*Sometimes, but less frequently, the word is spelled "mol."

†Since some writers today refer to the unit of structure as a molecule, the molecule in this sense is not the same as the atom for even monatomic elements. This confusion in the nomenclature of particle units, although unfortunate, is most likely unavoidable because of the dynamic nature of science. In this paper, the molecule is the particle represented by unit formulas or symbols in ordinary chemical equations.

Since the mole is the same as the gram-molecular weight, then it has the same significance and limitations. Like the gram-molecular weight, one mole also contains 6.06×10^{23} unit particles (atoms or molecules) and, in the case of gases at S. T. P., occupies a volume of 22.4 liters. It is well-known that, in the solution of stoichiometric problems, the gram-molecular weight is frequently confused with the gram-formula weight. This limitation or lack of consistency in the use of gram-molecular weight also applies to the unit "mole."

If the high-school student becomes familiar with the mole unit, he will be better prepared for future work in chemistry and its related fields. Not only is the word "mole" used throughout college courses, but authors and instructors seem frequently to assume that the student comprehends its significance. The only evidence, which is not very convincing, perhaps, that the writer can give for this statement besides his own experience as a student is that the word is not indexed in such recognized college texts as those by Brinkley([illegible]), Cartledge([illegible]), Deming([illegible]), and Sneed([illegible]), all of which not only use the word extensively but also define it within the first two hundred pages of their books. Other texts that were examined but which index the word are those by Briscoe([illegible]), Hopkins([illegible]), and Schlesinger([illegible]). Besides the foregoing books that were readily accessible, the writer also examined Bond([illegible]) and was astounded to find that there is a text in the college field that not only does not define the word "mole" but does not even use it. However, since Bond's book contains no problems, it is likely that those who use it as a text have an accompanying problem manual in which the word "mole" is used. Typical of related fields of chemistry in which the word appears frequently are those of bacteriology, chemical engineering, and agricultural chemistry.

If the idea of mole is applied to the solution of problems based on equations, the common mechanical and algebraic method would be replaced by logical reasoning and arithmetical procedure. That this statement is true can be best shown by an example. Suppose one had to calculate the weight of oxygen that could be obtained by the decomposition of 10 grams of potassium chlorate. Most high-school students would follow these steps:

(1) Write the balanced equation.
(2) Supply formula weights or multiples of them.
(3) Supply what is given, and "x".
(4) Solve for "x" by cross-products.

The solution of the same problem by the mole method would be:

(1) Write the equation.

$$2\ KClO_3 \longrightarrow 2\ KCl + 3\ O_2$$

(2) Reason as follows:

(a) Two moles of $KClO_3$ yield 3 moles of O_2.

(b) One mole of $KClO_3$ will yield 3/2 moles of O_2.

(c) But 10 grams of $KClO_3$ is 110/123 moles.

(d) The moles of oxygen obtained would be 10/123 x 3/2.

(e) But one mole of oxygen is 32 grams.

(f) Therefore, weight of oxygen is 10/123 x 3/2 x 32 = 3.9 g.

An analysis of the second procedure shows that the mole method requires logical reasoning and omits the use of algebra. That these features are real advantages may be ascertained by reading the pertinent articles by Burr ([10]) and Scott ([11]) and the text by Long and Anderson([12]). The oft-repeated statement that "if a student is able to solve the mathematical problems relating to the subject, then he understands the subject"([13]) is likely to be true in regard to equations if students can solve problems by the mole method. If one had to find the volume instead of the weight of the oxygen in the given problem, the only modification that would have to be made in the procedure as outlined above would be the substitution of *(e')* and *(f')* for *(e)* and *(f)* respectively:

(e') But one mole of any gas, at S. T. P., occupies 22.4 liters.

(f') Therefore, the volume of oxygen is (10/123) x (3/2) x 22.4 = 2.7 liters.

The appearance that the mole method is longer is only an illusion because of the presence of the written statements that are usually omitted. After the method becomes familiar the entire process is mental except for steps (1) and *(f)* which should be written out.

That the adoption of the mole method for the solution of problems will insure a better understanding of the significance of chemical equations has already been hinted. In addition to this effect on equations, the concept of mole also facilitates instruction in the balancing of them. Thus, for example, suppose one had to write the equation for the reaction between sodium peroxide and water. The student ordinarily proceeds as follows:

(1) Reactants and products:

$$Na_2O_2 + H_2O \longrightarrow NaOH + O_2$$

(2) Balance by inspection:

$$Na_2O_2 + H_2O \longrightarrow 2\ NaOH + O_2$$

At this stage, many students become helpless. If, however, they realized that they could logically place ½ in front of the O_2, the equation would be balanced and could then be cleared of fractions if the instructor required whole numbers. Students could be mechanically trained to do this same thing without the idea of mole; but they would be mentally handicapped because the instructor had previously taught them to interpret equations in terms of molecules and atoms and told them that they cannot have a fraction of these ultimate particles entering into chemical combination. With the idea of mole, however, since it is a concrete unit, there should be no mental hazard to understanding that it is all right to have fractional coefficients in a balanced equation. Another one of the many equations with which students find difficulty and which is easily balanced by the use of fractional coefficients is that for the reaction by which hydrogen is produced when aluminum reacts with sodium hydroxide and water.

$$Al + NaOH + H_2O \longrightarrow NaAlO_2 + \frac{3}{2}\ H_2$$

Teaching the Idea to High-School Students

Before the word "mole" is introduced to the students in high school, they should have been previously drilled on the significance of atomic, molecular, formula, gram-atomic, and gram-molecular weights, gram-molecular volume, and the balancing of some equations. Towards the end of the first semester, after the mole has been defined, they could be given introductory exercises on the use of it by the interpretation of equations in terms of moles, or moles and gram-atoms if the instructor prefers the two units. After they have learned the interpretation of the balanced equation in terms of moles, they could be taught and drilled on the variation in the number of moles of a product when some multiple or fraction of the number of moles of a reactant in the balanced equation is given. Then they could be shown how to convert moles to grams or liters. Review and summary exercises, similar to the following, could then be distributed and drilled upon until the students have mastered them:

EXERCISE I: Balance the equations and then interpret them in terms of the units indicated at the left of the blank lines.

	Cu (s) +	O_2 (g) ⟶	CuO (s)
(molecules)	______	______	______
(moles)	______	______	______
(grams)	______	______	______
(grams and liters)	______	______	______

EXERCISE II: Supply the missing information after the question mark. Carefully note what is given and the units required.

	2 Cu (s) +	O_2 (g) ⟶	2 CuO (s)
(a)	1 mole	______	?____moles
(b)	______	?____moles	5 moles
(c)	64 grams	______	?____moles
(d)	64 grams	?____liters	______
(e)	32 grams	?____liters	______

Other variations for pertinent drill exercises will occur to the alert teacher.

Students who have mastered the two exercises above for five or more equations should then be able to solve any weight or volume or weight and volume problem in high-school chemistry books. An effective plan would be to drill on such exercises at least once a week during the last two months of the scholastic year.

Additional types of problems involving the use of the mole unit for college-preparatory students could be those on the calculation of densities of gases and normal and molar solutions, especially if teachers agree

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Outdoor Leadership

• By **William Gould Vinal** (Cap'n Bill)
DIRECTOR, NATURE GUIDE SCHOOL, MASSACHUSETTS STATE COLLEGE, AMHERST, MASS.

Many city-bred Americans are hungering for the great out-of-doors. They know far too little about it. They want to learn. Formal classroom biology is unsatisfactory, but outdoor programs conducted by "nature guides", persons trained in the skills and techniques necessary for this new kind of leadership, do meet the needs of those who would learn about Nature from Nature. Massachusetts State College plans to provide such specialized training under the direction of the writer of this paper.

Cap'n Bill has had broad experience. His interests are many. He is a member of the faculty of National Camp, Life Camps, Inc., conducted in cooperation with New York University. He is Chairman of the Outdoor Recreation Conference and conductor of "Nature-Grams" for Recreation Magazine. A considerable number of professional nature guides have been trained under his direction. His new book "Nature Recreation" is reviewed in this number.

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Since those who are now seniors entered college there has been a "world of changes."

Biology has had its significant trends. There are at present seventy-seven nature programs being conducted for the general public in parks. A State Conservation Council (Massachusetts) sends forth a "gospel truck" on Conservation to summer camps. The Boston Childrens' Museum celebrates its twenty-five years of service. A hospital in Providence tries nature as a therapeutic for the mentally sick. Dartmouth College has a full-time naturalist stressing nature as a good investment for a future hobby. The Society of Recreation Workers of America adopt nature recreation as the year's goal. *Recreation Magazine* runs a nature news column called "Nature Grams." There has been an unprecedented epidemic of nature books that are readable and enjoyable to the lay public. Hotels are placing nature trips alongside golf as a public service. Blueprints for new trailside museums are keeping the engineers busy in Federal Recreation-Demonstration Areas. Such goings on are having an effect on the biology programs of secondary schools. Every one of these undertakings points to the human side of biology.

Possibly one great stimulus to changing to outdoor nature programs has been the government projects which have converted thousands of acres of submarginal land into great playgrounds and camping areas. Land zoning is bringing about wild life sanctuaries. Wildlife inventories, the Friends of Native Landscape, Youth Hostels, Walk-away Groups and a hundred and one related organizations are being born. Our parks are outdoor school rooms. They are already seeking a new kind of leadership. We would not think of spending millions on school buildings without a commensurate investment in providing an activity staff. The Nature Guide School of Massachusetts State College was organized to train leaders in the skills and techniques needed for these outdoor programs.

The school was really started in 1920 when the National Association of the Directors of Girls Camps sponsored the so-called Nature Lore School for the precamp training of nature counselors. It was held at Camp Chequesset, down on Cape Cod. There had been a general criticism of the formal leadership that was coming from the biology laboratory. The ambition of every leader seemed to be the teaching of a formidable list, which caused a rightful protest on the part of young campers. For eight years the Nature Lore School stressed the informal training of Nature counselors.

The Nature Guide School was finally established (1928) at Hudson, Ohio, on the first campus of Western Reserve University, the Yale of the West. The session was extended to six weeks and gave college credit. Field courses in geology, birds, flowers, insects, trees, and gardening were stressed. Practical leadership training was acquired in near-

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Spinning Yarns on Cape Cod.

Scientific Research in Catholic Institutions. *Part I*

• By Mildred De Primo
MARYGROVE COLLEGE, DETROIT, MICHIGAN.

Belief to the contrary nothwithstanding, a considerable number of Catholic universities and colleges are engaged in significant scientific research.

Undoubtedly, for reasons beyond their control, their scientists are not carrying on as many studies as they might desire. Additional schools which would gladly support research are unable to do so largely because of crowded teaching schedules and lack of funds. The product of the Catholic field, however, is far from insignificant.

The writer of this paper, a senior student at Marygrove College, Detroit, has spent considerable time in her survey of the leading Catholic institutions on the college level. The data she has collected are interesting. Only four institutions are mentioned in this paper. Others will be considered in a second article which will appear in an early number. Miss De Primo will not attempt to evaluate the achievements of Catholic researchers working at non-Catholic institutions.

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"To science, pilot of industry, conqueror of disease, multiplier of the harvest, explorer of the universe, revealer of Nature's law—eternal guide to truth." Thus reads the inscription on the dome of the National Academy of Sciences and the National Research Council in Washington. Every day in newspapers and magazines we read of the magnificent way in which scientific research is fulfilling the roles assigned it in this dedication. It is to research that modern medicine owes many of its miracles. It is through chemical research that a whole new industrial field, chemurgy, which is the union of agriculture and industry through chemical research, has developed. Research has indeed become the star to which the modern world has hitched its wagon.

But what is the part of Catholics in this scientific advance? We all know of such secular institutions as the Rockefeller Foundation, the Cancer Institute at Chicago, the Andrew Carnegie Foundation. Where are Catholic institutions in the scientific world? Father Thomas F. Coakley said:[1] "The Catholic Church has lost the intellectual leadership of the world; it is on the brink of losing the moral leadership of the world; . . ." The loss of the intellectual leadership and its consequence Francis E. Fitzgerald, in a later issue of *America*,[2] attributes in large part to the lack of Catholic research in an age of research. Is this still true? Is productive scholarship, Mr. Fitzgerald's term for research, still a minus quantity in the Catholic world? Emphatically, no. In the last ten years Catholic research has become something positive and something very positively important. Several of the many significant scientific contributions of the last decade have come from Catholic centers of "productive scholarship."

One of these Catholic centers is the University of Notre Dame. You may have never associated that university with synthetic rubber. Yet it was the late Father Nieuwland of the chemistry department of Notre Dame who gave duPont synthetic rubber, one of the most valuable of its many synthetics. This man-made rubber—its trade name is Neoprene—resists much more effectively than natural rubber the notoriously harmful swelling action of such solvents as kerosene and gasoline. Unlike natural rubber it can be vulcanized by heat alone without the addition of sulfur. This marvelous synthetic had its beginning in a discovery made by Father Nieuwland.

He had devoted himself for a long time to the study of the reactions of acetylene, with the purpose of extending and clarifying our knowledge of them. In the course of his work with one of these reactions he got as a product the gas, monovinyl acetylene, from which the duPont chemists, having obtained from Father Nieuwland permission to continue the work he had begun, finally produced a practical, and therefore valuable, synthetic rubber. And so, although it was the duPont workers who did the final work toward its production, it was Father Nieuwland in his pursuit of "pure research for the advancement of knowledge" who gave them the seed from which grew duPont synthetic rubber. Notre Dame is one Catholic institution which has reason to be proud of what research there has accomplished. No one would contest that statement were I to say no more about Notre Dame, but I must at least mention Professor Reyniers, another of its researchers.

Professor Reyniers, head of the department of bacteriology, has designed a unique contrivance, which he calls an "isolation cubicle." Its purpose is the prevention of cross-infection of babies in hospital and orphanage wards. These cubicles are equipped with an air-conditioning system and are so constructed that the air flows always away from the baby, with the result that the danger of epidemics, such as colds, the "flu," pneumonia, and others caused by air-borne bacteria, is considerably lessened. The well-known Evanston, Illinois, "Cradle" is now giving Professor Reyniers' cubicles their practical test; twelve of them are being used.

Another of Professor Reyniers' researches has resulted in the development of guinea pigs free from all

bacteria. These can be used, Professor Reyniers says,[1] ". . . as living culture tubes to study the progress of disease changes when a pure strain of bacteria is inserted into one of these animals. The disease develops free from help or hindrance from any other microorganisms." The results of the action of a specific bacterium on a live subject can thus be readily determined. Notre Dame, then, through the work of just two of its teachers, is notably holding its own in the field of research.

At Georgetown University the work of the Chemo-Medical Research Institute, founded on February 1, 1931, has already had practical results. Naturally most of the work at the Institute is biochemical in nature. Because of the importance of the relation of sulfur and sulfur compounds to vital activities in health and illness, a sulfur-containing compound called cystine, and the chemically related compounds, cysteine and glutathione, under which forms sulfur is commonly present in the human body, have been the subject of a great part of their research. The sulfur necessary to protect the body by combating harmful chemicals is liberated by these sulfur compounds. It has been found, too, that if there is to be normal growth, the cystine complexes must be present in the diet. Various methods have been devised for the determination of cystine, one of which was the work of Dr. M. X. Sullivan, the director of the Chemo-Medical Institute. Another result of the cystine research has been the discovery that there is generally a lowered cystine content in the finger nails of people suffering from arthritis. This finding suggested the use of sulfur to raise the cystine content and perhaps rid the patient of his illness. Colloidal sulfur has already been used as a remedy with considerable success.

Further research at Georgetown's Research Institute is directed toward the finding and perfection of tests for the early diagnosis of cancer. One test has already been devised but no definite conclusions have yet been drawn as to its value. The various departments of the university, too, are working on their own particular research problems. In a letter, W. C. Hess, associate research professor of chemistry, writes: "At the Medical School the Department of Pharmacology has been studying for some time the effects of hypnotics of the barbiturate type. The Pathology Department is investigating the effect of ultraviolet light on tumor growth. The Biochemistry Department in conjunction with our own laboratory is studying the determination of the amino acid tryptophane." Georgetown University has definitely established itself in the world of research.

The researchers in the biochemistry department at St. Louis University have, like those at Georgetown, distinguished themselves by their work with those chemical compounds so necessary to our life and health. At St. Louis, however, the work has been specifically concerned with vitamin K, the so-called coagulation vitamin. Because vitamin K is less well-known than certain of the others you must not think it correspondingly less important. For K is that very essential vitamin the presence of which in the system prevents hemorrhage and maintains normal clotting time of the blood. Since, however, two distinct compounds, each having vitamin K properties, have been found, K has become K_1 and K_2. K_1 is found chiefly in alfalfa leaves, and in most other green leaves and vegetables, such as spinach and cabbage; K_2 has been isolated mainly from putrefied fish meal. Although they have not yet succeeded in synthesizing vitamin K_2, the workers at St. Louis have confirmed the calculated composition of K_1 by its synthesis. Knowledge of the constitution of these forms of vitamin K is of value not merely from a theoretical viewpoint; its clinical application has already been demonstrated. Chemicals, similar in nature to the vitamins but of simpler chemical structure, and having antihemorrhagic properties have been used, although not extensively, with encouraging results.

This research is not, however, the only scientific work of which St. Louis University can be proud. For the researchers there, principally Dr. Edward A. Doisy, pioneered in that field which has gradually become a science in itself: namely, endocrinology. Medical science has just begun to realize the importance of the hormones which are secreted by the endocrine (i.e., ductless) glands. Yet in 1923, the workers at St. Louis had begun the study of the female sex hormones, the chief of which is theelin. A second substance, known as theelol, and probably the result of a chemical transformation of theelin, was discovered in 1930 by Drs. E. A. Doisy, S. A. Thayer, L. Levy, and J. M. Curtis. Some doubts have been raised as to which of these compounds is the chief hormone; but repeated experimentation has led them to believe that it is theelin. This experimentation also helped them find the molecular weight, melting point, probable formula, methods of preparation, differences in activity, these and many more of the necessary facts about the chemistry of theelin and theelol. St. Louis University, then, for nearly a quarter of a century has conducted fruitful scientific research, research which has earned for it a real place in the world of science.

Another notable Catholic center of research is the Institutum Divi Thomae, a unique institution whose importance is a result of its uniqueness. It was established by the Archbishop of Cincinnati in June, 1935, as "an institution for scientific research and for the training of limited numbers of research workers,"[6] having for its general purposes, ". . . the investigation of fundamental problems in various fields of science; the establishment and cooperative assistance of research laboratories at affiliated colleges, hospitals, and other institutions; and the consideration of science in its relation to philosophy."[6] Dr. George Speri Sperti, member of the Papal Academy of Science, is its director.

Since the main purpose of the training program at the Institutum is to develop as research workers of real merit those who show ability in creative research, the number of those permitted to study there is limited. The fortunate few study at the Institutum for three years. During the first year their rank is that of Assistant; the second year, they become Associates; at the end of their third year, the degree of Master of Science is given those who have shown themselves capa-

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NEW BOOKS

Photograph by Robert Turiff Hance

The Chemist at Work

• *By* ROY I. GRADY, JOHN W. CHITTUM, and others. Journal of Chemical Education, Easton, Pa. 1940. XV + 422. $3.00.

Here is a new book that can add sparkle to your teaching. It will bring information of such great value to your students that it could well be required reading. Vocational counselors will find the book helpful. So will young men and women with a leaning toward chemistry who are beginning to plan their lifework.

The Chemist at Work is a collection of some fifty carefully written, authentic, factual accounts of the work of chemists employed in as many different fields written by persons who are actually doing the work they describe. There are stories of workers in the glass, metals, sugar, ceramic, canning, petroleum and many other industries. Opportunities for the trained chemist in education, research, invention, in the literary field, in government laboratories and in medical technology are discussed. The place of women in chemistry is given special attention.

This book could well be required reading for teachers, too. *H.C.M.*

Handbook of Chemistry and Physics

• *By* CHARLES D. HODGMAN, Editor, and HARRY N. HOLMES, Associate Editor. 24th Edtion. Chemical Rubber Company, Cleveland, Ohio. 1940. XVIII + 2564. $3.50.

Previous reviews of this valuable reference book have pointed out its good qualities. All these have been retained in the new edition in which for the first time Harry N. Holmes of Oberlin College is listed as Associate Editor.

Numerous changes have been made throughout the book. The results of recent researches have been incorporated. The tabular form for physical constants of organic compounds has been reintroduced, the paragraph form of the previous edition having proved unsatisfactory. A new 65-page table of the physical constants of industrial organic compounds appears for the first time. It is said to be the only compilation of its kind in print.

The price of this useful book has been reduced from $6.00 to $3.50. *J.F.M.*

New World of Chemistry

• *By* BERNARD JAFFE, Brunswick High School, New York City. Silver Burdette Co., New York. 1940. XI + 692. $1.84.

This is a completely rewritten, redesigned, and reillustrated edition of the successful high school textbook of the same name which first appeared in 1935 and which was issued in revised form in 1939.

Two favorable reviews by different reviewers have already appeared in *The Science Counselor*. There is little to add to what has already been said except to note that the new edition is an improvement on those which preceded it. The scientific method is again emphasized. Much illustrative material is included. Individual differences are provided for. If this book is used as the author has planned it to be used, a unified understanding and knowledge of the fundamental facts of the science is assured.

The consumable edition of the attractive companion book, *Laboratory and Workbook Units in Chemistry*, by Maurice U. Ames and Bernard Jaffe, is priced at $0.92. *H.C.M.*

Growing Plants Without Soil

• *By* D. R. MATLIN, M.A., Belmont Evening High School, Los Angeles, Cal. Chemical Publishing Co., Inc., New York. 1940. 137 pp. $2.00.

This little book is marked by the enthusiasm of its writer. "Every man can be a Burbank!" "Perform magic in your garden!" It is quite different in tone from the Phillips book, "Gardening Without Soil".

Advertisements for this book state "The greatest advantage of chemiculture lies in the direction of improving the quality of food products, of mineralizing the foods, of adding color and perfume to flowers, and of perfecting new plants such as seedless tomatoes and hybrids."

Much useful information has been crowded into a few pages, but there is considerable additional material the inclusion of which in a book of this kind is at least debatable. In format the book is not outstanding. *H.C.M.*

Gardening Without Soil

• *By* A. H. PHILLIPS. Chemical Publishing Co. Inc., New York. 1940. 137 pp. $2.00.

An illustrated, temperate, and sound evaluation of the present status of the soilless growth of plants. The author considers this method of gardening an important advance in under-cover cultivation, but one that is suited for out of door use only in certain climates. Claims that hydroponics will eventually supersede ordinary gardening are unfounded and ridiculous. Overpublicization of the new method has been harmful.

This book gives practical information concerning plant growth, equipment, materials, and procedures. Both water culture and aggregate culture are studied. Six nutrient solutions are recommended for use by the beginner. There is a brief bibliography but, surprisingly, no index. *H.C.M.*

The Badianus Manuscript

• (Codex Barberini, Latin 241) Vatican Library. An Aztec herbal of 1552. *Translated by* EMILY W. EMMART. *Foreword by* HENRY E. SIGERIST. XXIV + 341 p. 122 pl. (90 col.), 2 fig. Johns Hopkins Press: Baltimore, 1940. $7.50.

This herbal, America's earliest known medical book, after remaining in obscurity for almost 4 centuries, was discovered by chance in the archives of the Vatican Library in 1929. With the consent of the Pro-Prefect of the Library, complete photostats of the manuscript were obtained for the Smithsonian Institution at Washington, D. C. The brilliant colors of the original Aztec drawings of some 179 medicinal plants were carefully reproduced in aquarelles. The little book (8x8⅛x¾"), bound in crimson velvet, is the work of two Aztec Indians, Martinus de la Cruz, a native physician of the College of Santa Cruz in Tlaltelolco, who composed the work in Aztec, and Jaunnes Badianus, a reader in Latin in the same college, who translated from the Aztec into Latin. The dedication states that the manuscript was written by a native Indian at the request of Don Francisco Mendoza and was intended as a gift to "His Holy Caesarian Catholic Royal Majesty," Charles V.

The present volume contains a complete facsimile in full color of the Vatican manuscript, supplemented by chapters dealing with the discovery of the manuscript, its historical background, symbols employed, and the mythology and medicines used by the Aztecs, together with a chapter on Aztec gardens. The transcription and translation are copiously annotated (footnotes), and where possible the plants used and pictured are identified and the modern botanical equivalents given to the Aztec names used in the manuscript. Full indices and a bibliography conclude the volume.

M. J. Fisher, "Biological Abstracts."

Nature Recreation

• *By* WILLIAM (CAP'N BILL) GOULD VINAL, Massachusetts State College. McGraw Hill Book Co., Inc., New York. 1940. XI + 322. $3.00.

"Climbing apple trees, chasing butterflies, hunting frogs, fishing for bullheads, gathering shagbarks, making mud pies, harnessing brooks, pushing across a pond on a raft are the serious occupations of childhood" and "It is the duty of every parent to see that children are not robbed of the early enjoyment of nature play". This may involve pets, and if parents and teachers deny children pets they should remember that "The child who is starved for the lack of pets has failed to that extent in developing his own personality" and "a child cannot gain the friendship of his pet unless he observes certain laws. These are the same laws by which human friendships are attained".

Would you entrust your child to a teacher or a camp counsellor who has such ideas? Thousands have! and when Cap'n Bill (Vinal) continues to drop such admirable admonitions throughout his new book "Nature Recreation", you follow right along and "soak up" every word of it.

Teachers, camp counsellors and directors, school and other city administrators are going to be interested in what Cap'n Bill has to say about the place and responsibility of nature recreation, sex education, and conservation education in home, school, community, and camp.

Have communities become more nature conscious? Do we have enough nature leaders trained for the present opportunities? Which schools and training centers are fulfilling this important obligation to the country? Where can you find active nature programs? Why does Cap'n Bill say that every community with a population of 25,000 or more needs a full-time nature guide? These are the questions which you will want to answer with the help of "Nature Recreation".

If you are a nature guide, whether in school, camp, home, or community, you will want to see the wealth of suggestions in Part II devoted to "Applied Nature Recreation." There you will find chapters on: tools for leadership in field work, leadership responsibilities on hikes and overnite trips, including many favorite outdoor recipes, suggestions for experiences with birds, gardening, insects and spiders, pets, physical things, trees and forests, and wildlife management. These are not theoretical either, they have been tried and found to be worth passing on to you.

One chapter on nature games for rainy days, for outdoors, and just for plain fun, makes you want to be the child again and not the leader. You rightfully ask why you were never taught such games or permitted such fun in camp and in school.

A chapter showing how you and your community can make nature recreation an important part of your living gives you the answer to your question, 'Well, what can I do about it".

My congratulations to the author and to McGraw Hill for producing a fine, well-organized book, which is full of substantiated and interesting facts, which is well illustrated, and which has a most useful series of references and positive suggestions throughout. It fully lives up to its professed statement of "being a practical guide for group leaders". It has many new nature experiences and adventures for you and you will enjoy reading it and using it for a text. Every camp and school library should have it and if the book finds its rightful place, it will be in every classroom and home where nature is to be taught. I have organized a course around this book for the training of nature guides for school and for camp and community, and I plan to use this book as the text.

Richard Lee Weaver, Dartmouth College.

Demonstration Experiments in Physics

• *By* RICHARD M. SUTTON (Ed.). McGraw-Hill Book Co., Inc., New York. 1938. 510 pp. Illustrated. $4.50.

This valuable collection of demonstration experiments was prepared under the auspices of the American Association of Physics Teachers. Twelve collaborating editors assisted Professor Sutton in the search for suitable demonstrations and in the necessary examination of the many experiments contributed by members of the Association and others. From this cooperative undertaking has come a volume which should be invaluable to the teacher of physics. Here he may find a wealth of experiments and many excellent suggestions on the art of effective demonstration.

The first 14 pages are given to an introduction and to a discussion of the principles, methods and tools of the successful demonstrator. This discussion, based, at it is, upon the experiences of many teachers, can hardly fail to be of value to beginner and veteran alike. The former can find in it those principles of success which only years of experience could reveal to him, and then perhaps only incompletely. The latter is more than likely to find in the discussion some important principle to which he has failed to give sufficient attention and which, recognized in his own demonstrations, will make them more effective. A number of devices which may be used to increase student interest are

noted and their place in the scheme of things evaluated. The discussion is balanced and sensible and (let us give thanks!) free from that hackneyed variation on the theme of "motivation" and "fitting the student for life", too often substituted for clear and original thinking by those who attempt to set forth the how and why of teaching.

The demonstration experiments, to the surprising number of 1189, cover the entire field of physics. They are simply and briefly described, without inclusion of unnecessary details. There are many well drawn figures. Simple apparatus is favored throughout, so that much of it can be made without difficulty or purchased at small cost. The great value of the book lies in its wealth of material and ideas and in its adherence to the principle that "demonstrations are for the student and not for the instructor". The editor believes too that the primary purpose of the demonstration is to instruct the student, not to entertain or mystify him. This is sane and worth noting in these days when a very proper emphasis upon student interest often is exaggerated into pure showmanship, educationally as barren as the tricks of a magician. In keeping with this, simplicity of apparatus and action is favored, first of all because it is most effective, secondarily because it best fits the average teacher's allowance of time and money.

We recommend this book without reserve. *G.E.D.*

CHEMISTRY TEACHERS, *Attention!*

Here is a new and important visual aid. It is recommended for the favorable consideration of teachers of chemistry in high schools and colleges.

Princeton University is now selling *at cost*, for school use, a film strip containing pictures taken from general chemistry textbooks, books on popular science, and industrial news. Four hundred pictures, covering a wide field, are supplied on a strip of 35 mm. film. The school itself cuts out the individual frames and mounts them on 2" x 2" slides, thus providing 400 separate slides. A simple system of indexing based on the periodic system is suggested. The issuing of other film strips is contemplated.

Suitable slide mounts can be purchased at $1.20 for fifty, but home-made ones will do very well. Satisfactory projectors are available at a price under $10.00. Information concerning slide mounts and projectors is furnished with the film.

The film may be obtained by sending a check for $5.00 to Prof. H. N. Alyea at the Frick Chemical Laboratory, Princeton, New Jersey. The check should be made to Prof. Alyea.

We "counsel" you to consider this service for your school.

Oblate Missions

Continued from Page Four

are *allothigenous*, that is they have been transported to a certain distance from the place of origin and are sedimentary.

As for the organic matter serving for the formation of the humus of these *authigenous* soils it could not take its origin from the decomposition of the higher plants, trees, etc., since these are absent in this barren land. Hence, it necessarily comes from the lichens which are so abundant on the same rocks from which have come the inorganic matter, the sand, the clay, etc.

The phenomenon of disintegration of rocky surfaces in the Arctic is more effective and rapid than in any other area on the globe. The diurnal fluctuation of temperatures from 15°C to 0°C is very frequent in the course of the short Arctic summer. All these rocks, denuded after the melting of the snows, contain a certain quantity of water of "imbibition." This is frozen by the cold nights below 0°C. The rocks expand and contract and thus are subjected to enormous pressure which causes them, however resistant they may be, to break and splinter, crumble and pulverize in a relatively very short time. The other factors of destruction of the rocks, such as mechanical, chemical and biological forces, seem almost negligible in comparison with the effect of freezing and thawing in effecting this demolition of rock.

A striking characteristic of the Arctic soils is the high percentage of particles larger than 2 millimeters. This can reach as high as 97%, found, for example, in one of the soils of Churchill which, however, is productive and carries some advanced types of vegetation such as the heaths, etc. (See condensed report.)

It is well to distinguish the *authigenous* soils from the *tundra* soils which have a subsoil perpetually frozen, whereas the authigenous have no subsoil, unless we distinguish them from the *tundra of the plains* by considering them as *tundra of the mountains*. In order to determine better the relation between the inorganic and organic matter (humus) of these soils, we have chemically analyzed the lichens as well as the rocks on which they grew. This analysis shows the content of carbon, (24.14%), lower than that in other and higher plants, (45%). On the other hand the percentage of nitrogen is much higher.

To explain this curious phenomenon it seems as if Arctic atmospheric conditions must be considered. Further, the food value of these lowly plants, relatively high in nitrogen, assumes additional importance, a fact too complex to be considered in so short an article as this. We may simply add that these lichens are also notably rich in potassium, phosphorus and aluminum, an evident result of their connection with the feldspars of the granite gneisses of this geological conformation, on which they grow. ●

Confessions of a Gadgeteer

Continued from Page Twelve

the increased length of the water column, the device may conveniently be made to show a deflection of, say, one inch for each foot per second per second acceleration.

The same principle of manometer practice has been applied to a barometer of special design. I have always wanted to construct a water barometer to give, like Otto von Guericke's, wide variations of level with changes of atmospheric pressure. However, such a barometer must of necessity be more than 30 feet high. Figure 5 shows a barometer employing mercury to sustain most of the atmospheric pressure, and water to record most of the *variations* of pressure. The whole instrument is no longer than an ordinary mercurial barometer, yet the variations in water level are 12.8 times as great as the variations in mercury level in a standard barometer. During the past year, for example, the instrument has been observed to vary 60 cm.! The fiducial point for the mercury level is conveniently situated within the upper bulb at P; the level of the mercury is controlled by a plunger in the side tube at T. Since the water tube is open at W, through a capillary, water vapor pressure does not affect the readings and the instrument is relatively free from temperature corrections of large magnitude. Such is not the case if the water is in the evacuated part of the system, either in the water barometer, or in the mercury-water modification using this same principle of multiplication but having the water above the mercury in the closed part of the system. The only handicap of the gadget is that the water level goes down when atmospheric pressure goes up.

A simple and inexpensive monorail car is illustrated in Fig. 6. It consists of a board with two pulley wheels which run on a supporting wire; a twenty-five-cent gyroscope top mounted upon a transverse axis stabilizes the car, provided the top is free to precess forward and back about its transverse axis AA′, while the car as a whole careens from side to side about an axis BB′, at right angles to this. The car will maintain equilibrium for about 30 seconds before the amplitude of motion of the top becomes too great, and it may be made to run down a wire or thread stretched across the classroom.

The measurement of centripetal force required to hold a ball to a circular orbit is easily accomplished with the simple apparatus shown in Fig. 7. A glass tube with ends made smooth by heating in a flame is held vertically and rotated in a small circle by hand so as to swing a rubber ball on the end of a piece of fishline which passes from the ball through the tube to a heavy mass, M, hanging below the tube. It is evident at once that the force which holds the rubber ball to its circular orbit is supplied by the pull of the earth on the large non-rotating mass M, which may be many times the mass of the ball, *m*. If desired, the fishline may be marked so that the operator can maintain any specified radius of rotation for the ball, and then by timing and counting it is possible to check the law of centripetal force with tolerable accuracy. The apparatus seems to appeal to students because it shows so obviously the magnitude of the centripetal force, and, furthermore, shows that this force may be many times the weight of the ball.

The center of gravity of a body plays an important part both in statics and dynamics. I like to show that a body naturally rotates about its center of gravity regardless of how it is tossed into the air. First find, by balancing, the location of the center of gravity of a hammer and mark the spot clearly with chalk or paint. Toss the hammer into the air and observe how it rotates about this spot. Then, if desired, spin the hammer with a hand-drill by means of a nail driven into its handle at the center of gravity, and show how smoothly it turns.

As a surprise modification of the preceding experiment, I have prepared a 10-inch wooden disk which may be tossed into the air. The disk rotates about its center of gravity at the center of the figure, about an axis clearly marked with a bright colored circle. After one or two tosses, I insert a brass rod into a hole bored along a chord of the disk and toss the disk again with the same side facing the class. The disk wobbles badly, but if it is now tossed with the *other* face toward the class it will be seen to execute a regular rotation about a new spot situated off-center at the new center of gravity. Even such a simple gadget as this offers plenty of chances to use calculus! For example, if the center of gravity is to be shifted by the maximum amount, where should the hole be drilled to take the metal rod? As shown in Fig. 8, the hole is situated at a distance $0.707\ R$ from the center; it is evident that a second hole must be drilled symmetrically with respect to this one so that the center of gravity of the unloaded disk shall still be at the geometrical center of the figure. If the disk is handled carefully, the element of surprise never fails to provoke interest.

The flattening of the earth at its poles because of rotation can be shown in exaggerated form by spinning a sponge rubber ball at high speed with a motor. I use a 10-cent ball, 3 inches in diameter, suspended by an iron wire from the axis of a small 110-volt series-wound universal motor which spins the ball at several thousand revolutions per minute. The wire is held to the axis by a single-hole rubber stopper. When the speed is high, the ball flattens into an ellipsoid with ratio of axes about 2 to 1.

The experiment may be modified by using a 4 inch rubber ball on which is painted a map of the earth. While it is being rotated a stroboscope will "stop" the motion, thus giving one a look at the deformed continents under conditions of high speed rotation.

"Beats" in sound are nicely shown by two small brass whistles equipped with machine screws to change their pitch.[3] If both whistles are blown loudly, the beats may be so numerous as to cause the sensation of

a "beat-note" whose pitch can be made to run up and down the scale as the difference in frequency of the two whistles changes. Absence of beats is found only when the two are in unison. If, when there are no beats, one of the whistles is heated by a lighted match, beats reappear because of the increased velocity of sound in the warmed whistle and the consequent rise of pitch. Or one of the whistles may be blown with illuminating gas to show the dependence of pitch upon the density of the medium in which sound travels, since the velocity of sound varies inversely with the square root of the density.

These simple gadgets, arrangements, and experiments are but a few of those that might be described, but they illustrate the point which I should like to stress in connection with demonstration experiments and instruction in physics: equations and principles can be made vivid by gadgets, and in many cases the simpler the gadgets are, the better. I invite every reader, whatever he teaches, to cultivate his own imagination for the benefit of himself and his students. ●

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Things of Science

Continued from Page Five

ments which may be registered with the Government or kept in a safety deposit box. Members will be told how to classify the arches, loops, whorls and composites in any fingerprint.

Fabrics Unit.—Members will receive a piece of cloth spun from glass; a fabric made from milk which feels like wool; a silk-like cloth made from salt, lime and air; a sheet of paper that feels like cloth; and other new fabrics which are products of scientific experiment.

Meteorite Unit.—Members will receive an actual chunk from the heavens, a pebble of iron-nickel meteorite—one of Earth's only imports from the outer space! It is certified to be an actual meteorite fragment such as can usually be viewed only in certain museums. Members will also receive some of the sand pulverized by the tremendous impact of one of the largest meteorites ever to hit the Earth. With these materials members will receive a stirring explanation of this unusual exhibit. ●

Scientific Research

Continued from Page Eighteen

ble of constructive and original research. Since the Institutum does not try to achieve what the ordinary graduate school aims at, its program is different, its methods are different, its entire system is wholly unlike that of the graduate school; hence the degree it grants is ". . . not intended as a qualification for teaching. Its purpose is to represent the completion of a research training period at the Institutum and the proven capability of the recipient in carrying on creative scientific research."[7]

It is in this careful fostering of the talent for research, a talent which too often is wasted for lack of sufficient training of the right kind, a talent which too often is turned into other fields for want of just such an opportunity as the Institutum presents—it is in this that the Institutum is doing a very real service to science. It is this work which gives this unusual institution its outstanding importance.

In a discussion of the importance of the Institutum, however, the actual results of the research accomplished in the past five years cannot be ignored. The papers of the researchers at the Institutum have been published in its own publication, *Studies of the Institutum Divi Thomae*, and in other scientific journals as well. Among the more interesting studies are those on cancer and on the vitamins. The emphasis in the cancer research has been on cellular physiology; for Dr. Sperti, and certain of his associates who had worked for many years in this field before the founding of the Institutum realized the necessity of a more clear-cut knowledge of ". . . the abnormal physiology of the cancer cell and, if possible, the finding of methods of changing this abnormal metabolism to a more normal kind as the chief hope in the control of cancer."[8] The development of cell products as a result of cellular irritation and injury in relation to tumor growth is one of the phases of the cancer studies. Work on the vitamins has been concerned chiefly with the absorption of vitamins A and D as a result of topical applications. That vitamins so absorbed are effective as protection against their respective deficiency diseases has been proved.

The survey pamphlet published by the Institutum at the beginning of the year shows that work at the Institutum has included research in the following fields: plant physiology, genetics, chemical spectroscopy, biochemistry, biophysics, synthetic organic chemistry, optics, and philosophy in relation to science. The comprehensiveness of the research at the Institutum could not be better shown than by this list; the solutions of the more important problems in the fields of biology, chemistry and physics are evidently receiving the attention they deserve. Not only is the Institutum achieving a very practical and a very necessary end in the development of creative scientific researchers, but it is at the same time successfully carrying on pure research.

That Catholic institutions in this country have made a place for themselves in the world of scientific research should no longer be a matter of doubt. Scientific research at Notre Dame, Georgetown, and St. Louis, is at least equal in its results to that in progress at corresponding secular colleges and universities. The Institutum Divi Thomae fills the place in the Catholic research corner which in the secular world is filled by such institutions as the Rockefeller Foundation. Only four instituions have been considered in this paper, and the information given about them merely sketches a few of the important results they have achieved. The writer is now collecting data concerning other colleges and universities, and the results of the survey will be published later in *The Science Counselor*.

The importance of Catholic research, however, lies not merely in its contribution to science, to the enrichment of knowledge, but in this contribution as a means to another, a truly Catholic end: Catholic moral leadership in an amoral and anti-moral world. Let me explain. Someone has said that it is only through regaining the place we have lost in the intellectual world that we can hope to reestablish a Christian moral order. The way to achieve a place in the intellectual world in an age devoted to science and scientific research is to do precisely what is now being done: found and foster research programs; continue such vital research as that on cancer, the vitamins, the hormones; lastly, raise up

a new generation of trained research workers. We are using the proper means; the end, Catholic intellectual and, finally, moral leadership, we cannot help but achieve. ●

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Phototropism

Continued from Page Nine

The number of trials which will give data adequate for drawing conclusions is a subject worthy of class discussion. Many of our superstitions are based upon personal observations of too few cases, plus, of course, a prejudiced mind. Thus, pupils, with these experiments, are laying the foundation for one of the most important phases of the scientific method.

Many variations on the experiment are possible. What, for instance, is the difference in reaction of a number of individuals; do some respond as quickly and as surely as others? Do single individuals respond consistently even while there is variation in a species? Again, is there variation in related species?

An interesting study attempts to connect the life habits of organisms with their reaction to light. For example, do organisms living in dark places, such as millipedes, react negatively in the box? Will grasshoppers react negatively or positively? What is the reaction of night-flying insects?

It is possible to vary the conditions attending the experiments. The clear cellophane may be replaced by a single color of cellophane and any change in response noted. Or two colors, one in each end, may be used, to discover any tendency toward selectivity.

If a photometer is available, such as one used by photographers, the effect of different light intensities can be tested. The writer has discovered that some organisms are not affected by any but very bright lights.

Dr. Palmer, in the leaflet mentioned above, tells of an interesting relation between the reaction of clusterflies and the two factors of light and temperature. When temperatures are low, the flies react negatively, trying to push their way into crevices and corners. When temperatures rise above a certain figure, the flies move toward light. Since clusterflies are abundant in attic windows on sunny days in winter, there is no lack of material for experimentation. Many high school pupils enjoy discovering the critical temperature at which the change in reaction takes place. For follow-up work, temperature readings in an attic can be used to discover whether the flies react similarly there.

What are the applications that can be made from these experiments? It should be appreciated, of course, that one must use caution in making positive statements regarding such applications. The conditions of the experiments are not comparable to those in nature. But speculation is possible, and speculation lays the groundwork for further study.

At the New Hampshire Nature Camp, it was found that grasshoppers reacted positively to light, cockroaches reacted negatively, crickets were indifferent. In the first two cases, one might say that such responses prevent the organism from getting into an unfavorable environment. It was not proven, of course, that the reaction was responsible, but the basis was laid for further research.

In the case of the clusterflies, one might feel fairly safe in assuming, after checking the responses of the flies in attics, that the response was definitely advantageous. Cold weather causes the fly to work its way into a protected place; warm weather causes it to come out where it can resume its normal functions.

Recently, it was discovered that the nymph of a certain species of mayfly, which reacted negatively to light from the time of its development from the egg, and was always found beneath stones in brooks, developed a positive response just before its final moult. It seems certain in this case, that the change in response enabled

the insect to leave its sheltered position and find its way to the top of the water just when the need for such change was necessary.

Not only will pupils have an excellent opportunity for learning to do scientific research in these vast, unexplored fields, but they will also be beginning to understand the complexities and the niceties of existence. Certainly, no worthier objectives of science teaching can be found. ●

New Form of Animal Life Found in Nevada

Six different forms of animal life have been found to date in Lehman Caves, Nevada.

Latest to be added to the list is a species of tiny white worm, first observed on the wet rocks and subsequently found to be quite numerous. The worms appear to be larval Diptera, although definite determination cannot be made until a specimen is dissected. If Diptera, they are probably the larvae of the small black midges which frequent the caves at certain seasons.

Discovery of the worms suggests many questions: what is their life history? Do the adults spend their entire lives within the caves? Is this an example of a surface insect evolving into a cave dwelling form? Further study may give science the answer.

The Use of the Word *Mole*

Continued from Page Fifteen

with Carleton[11] that all graduates of standard secondary schools should be able to do problems on standard solutions.

Summary

In this article the writer has attempted to show why the mole unit should be used and how it can be taught in high-school chemistry courses. The reasons given for its adoption are that the concept does not introduce anything new since it is a briefer form for gram-molecular weight, that higher courses are organized on the assumption that students understand the word "mole," that its use in the solution of problems will substitute logical reasoning and arithmetical procedure for mechanical steps and algebraic method, and that the comprehension of the meaning of "mole" necessitates a better understanding of the significance of equations and leads to dexterity in balancing them. With regard to teaching the application of the mole unit, it is likely that this work could more successfully be presented as supplementary to the general mechanical and algebraic solution of problems rather than as a substitution for the traditional practice.

The writer was disappointed to find so little in the literature on this important teaching problem. The

texts on the teaching of science or the teaching of chemistry by Downing, Frank, Preston, and Twiss make no reference to it whatever; nor do the specialized drill, review, and calculation booklets by Beisler and Heath, Darrow, Gooch, and Unger. Arenson's *Chemical Arithmetic*(15) does contain problems involving the "mole." ●

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Alcohol

Continued from Page Two

generally accepted as the rate of oxidation, another useful piece of knowledge. If the amount consumed exceeds the rate of burning and excretion, the concentration in the blood increases.

Psychological Effects of Alcohol

From the standpoint of the young man or woman, the points of greatest interest are the influence of alcohol on memory and learning, on attention and concentration, on thinking and reasoning, and on the psychology of accidents.

It is well established that a concentration of alcohol in the blood sufficient to produce no demonstrable effects of incoordination of body movement may yet produce an impairment in efficiency in learning. The psychologist demonstrates by an example of students solving problems in arithmetic. A pair of numbers requires for solution a specific mental associate, which has been well learned in the past. The question is whether after ingestion of alcohol the mind will be inhibited and confused, or will it be facilitated and quickened. Twenty students about 17 years of age are divided into two groups of ten, after ascertaining their normal performance. Group A works with alcohol, B without. Group A's performance is from five to twelve per cent poorer than Group B which used no alcohol. Repeated experiments and trials with different doses give continued evidence of alcohol's interference with the ability to perform an important type of mental work.*

* From *Alcohol and Man*—Emerson, 1932. The Macmillan Co.

Although mental activity may be impaired from a standpoint of accuracy, the responses may seem to the observer unusually apt or witty. Lack of attention and inability to concentrate on the problem at hand are demonstrated by similar experiments. Employers generally, as objective observers of those who use alcoholic beverages, claim that detrimental effects result from the practice of drinking while on duty.

In thinking and reasoning it is generally agreed that when normal individuals imbibe even moderate amounts of alcohol the intellectual output suffers. This is explained by the fact that the drinker so commonly fails in his mental work of self-checking, and there is a clumsy mental fumbling for solutions similar to the clumsiness of movements of the hands and feet, even though these movements may not be present.

Alcohol in Accidents

The prominent place of the motor car in our lives today makes an understanding of the effects of alcohol important. If we would generally recognize that alcohol anesthetizes and depresses the higher mental functions in a manner all the more dangerous because it often passes unrecognized, the high rate of accidents could be lowered. Alcohol taken in amounts of not over 30 cc. may produce sufficient depression to impair vision, to slow mental associations, and to produce a feeling of "cozy remoteness from the outside world." The driver of a car requires integrity of mental and

muscular ability. The driver with even a mild alcohol concentration in his blood has been described as feeling no special responsibility for his irregular behavior. He may even find amusement in observing himself doing odd things "Unless genuinely frightened or sharply checked by a sudden recognition of his responsibility, the person who ingested alcohol has no adequate sense of his own status as a driver."

Alcohol in Crime

Today, it is generally agreed that the relationship of alcohol to crime is not a very specific one. Does alcohol stimulate criminal tendencies? There is no agreement among criminologists on this point. Under the conditions described above, however, it is clear that alcohol, acting as a depressing agent upon mental activity, may produce situations from which a criminal act may result. This disturbance of functioning so commonly associated with alcohol has contributed perhaps more than anything else to the widespread belief that alcohol is one of the greatest causes of crime.

The teacher can do no better than to teach a straightforward account of our knowledge of the effects of alcohol. The young man accepts his responsibility if he knows the truth. Prior to this knowledge there appears no natural barrier to the unrestricted consumption of alcohol. Taste or total volume do not constitute a safe rule in judging how much alcohol one may drink. Subjective effects are the guide to the drinker, particularly the moderate or temperate drinker.

Summary

The following scientific information represents a fair summary of our knowledge of alcohol and man:

1. Intoxication is related to the amount of ethyl alcohol in the blood, irrespective of the character of the beverage, the quantity imbibed, or the experience of the drinker.
2. Dilute solutions of alcohol are less intoxicating than strong solutions containing the same amount of alcohol.
3. Food inhibits intoxication by its action in preventing the absorption of alcohol from the alimentary canal.
4. Alcohol is burned in the body and excreted at a constant rate. If intake exceeds excretion, the blood concentration increases.
5. Alcohol exerts a depressant action upon the brain. It produces a subjective feeling of euphoria and a blunting of self-criticism with a corresponding decrease in mental efficiency.

Recognition of these fundamental facts must underlie consideration of any other aspect of the alcohol problem and the adolescent. ●

Physical Science

Continued from Page Eight

ability to use conscious techniques of problem-solving and to apply principles is a more important outcome of instruction.

8. Activities and pupil participation must be the core of the course.

9. The development of a modern science curriculum should result from cooperative, democratic procedures involving all teachers, supervisors, and any others who are concerned with it. If prescribed courses and methods are imposed from above on unsympathetic teachers, the full potentialities of both the teacher and the course are unlikely to be realized.

In Summit we are now in the midst of revamping our testing program to harmonize with the philosophy and the objectives of our courses. The following tentative hypotheses are guiding us in the development of new tests and evaluation techniques:

1. Tests and test items should be directed toward the curricular and course changes and goals which are desired.
2. The testing program should be comprehensive and include all aspects of instruction.
3. Testing measures and test items should apply to functional situations.
4. The worth of the methods of teaching and the materials of instruction in a given situation is unknown until their effect is measured.
5. Evaluation programs are an integral part of the teaching process and should facilitate, rather than hamper, the attainment of objectives.
6. Testing is the direct concern and responsibility of the classroom teacher; tests should not be imposed from the outside, but should be developed as an integral part of the course.
7. Tests and measures should be as reliable and as valid as possible.
8. Tyler: "Teachers teach for what is in the test. Show me who makes the tests and I'll show you who re-makes the curriculum." Look at the tests, and you'll discover the real objectives of the course.

The following are suggested worthwhile objectives of science instruction, other than mastery and understanding of subject matter:

A. Application of facts and principles to new situations.

B. Interpreting data and drawing reasonable generalizations from data new to the student.

C. The nature of proof.

D. Interpreting graphs, charts, tables, etc.

E. Scientific curiosity or interest in natural phenomena and in solving science problems.

F. Scientific attitudes.

G. Recognizing cause-effect relationships.

H. Familiarity with reliable sources of information on science problems.

I. Recognizing unsolved problems in science.

J. Ability to plan experiments to test hypotheses.

K. Skill in laboratory techniques.

L. Ability to observe phenomena accurately.

Now let us turn specifically to the physical science course and see what the adjustment areas and problems are. Consideration of our environment reveals that man is called upon to make adjustments to the following forces and materials, or complexes of forces and materials:

I. MATERIALS NECESSARY TO LIFE — AIR AND WATER.
II. MATERIALS OF CONSTRUCTION.
III. POWER AND MACHINES.
IV. FIRE, FUELS, AND HEAT.
V. THE SKY.
VI. THE CRUST OF THE EARTH.
VII. WEATHER AND CLIMATE.
VIII. LIGHT AND VISION.
IX. SOUND AND ITS COMMUNICATION.

The adjustment problems within each of the above areas tend to follow a similar pattern; that is, there are a rather few definite types of major problems relating to fuels, light, construction materials, etc. These types are stated as follows:

1. How Does Man Obtain, Provide, Produce, etc.?
2. How Does Man Purify, Refine, Adapt, etc.?
3. How Does Man Distribute, Transmit, Transfer, etc.?
4. How Does Man Control, Regulate, etc.?
5. How Does Man Conserve, Protect, Preserve, etc.?
6. How Does Man Select, Use, Conserve, Utilize, etc.?
7. What or How Has Man Learned About, etc.?

The last type of problem would, of course, relate to such areas as the sky, and the past history of the crust of the earth, in which the adjustment problems are largely intellectual.

It is hoped that you who have read this article have said or thought, 'It sounds good—but how do you put these ideas into practice?" In the next issue of this magazine there will appear a typical physical science unit—Fire, Fuels, and Heat—outlined for teaching purposes, complete from preview to comprehensive test, and including demonstrations, activities, readings, films, suggested projects, suggested investigations, and organizational activities. ●

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Science Fusion

Continued from Page Six

Now that we have discussed the causes and have traced some of the developments of our diseased science teaching, the next step should be to suggest a cure. But, when we attempt to apply the remedy, we must keep in mind the patient's condition. We do not want a "blitzkrieg," or even a New Deal. We know that the effects of revolutions and sudden changes are often disastrous. Our plan for a cure should be simply this: let us *save the good and discard the bad*. First, we need a program.

This problem is not a new one. During the last decade plans for improving secondary-school science have been discussed in many parts of the country; several programs have already been proposed. Let us examine some of these programs and see what they have to offer.

In New York, Dr. Knox, State Superintendent of Public Instruction, advocates the following: general science in grades 7, 8, and 9; general biology in grade 10; physics in grade 11; and chemistry in grade 12. He also mentions the need of a modified course for the slow-learning group. In this connection he makes some interesting comments on fused courses. I quote from Dr. Knox.

"Various experiments are being conducted with integrated physical-science courses that are designed to *replace* physics and chemistry. To advanced students and particularly to research workers who have been brought up through formal physics and chemistry and who are able to stand on a pinnacle of science knowledge, many integrations may appear to be possible; and, from their adult and advanced point of view, a survey or integrated type of science course may appeal as a royal road to learning. From this point of view (they say) it is not necessary for the learner to struggle through a maze of separately organized courses in physics and chemistry. Perhaps they forget that it was through this very process that they themselves have been able to reach the position where they can appreciate the integrations which appear at an advanced level. This artificial organization of subject matter is proposed as a substitute for the more traditional physics and chemistry. It is claimed that this organization is more psychological than the other. There is no evidence to support this contention.

"It is by no accident that man has, through the last hundred years, or more, gradually organized bodies of knowledge that have come to be known as physics, as chemistry, or as the biological sciences. There is something very fundamental and natural in such an organization. Although this division of subject matter is so often damned as being traditional and out-of-date, it is possible that there still may be something very psychological about it. The organization of chemistry in terms of names of substances, occurrence, preparation, properties,

and uses, has been criticized frequently. But it happens that this treatment is very similar to that discovered in questions of interest concerning any new product. What is it? What will it do? Where does it come from? and What is it good for? A typical chemistry course contains learning materials that seem to have a rather deep-seated appeal to most students. There is something fundamentally satisfying to maturing pupils in a definite organization of materials and the sound psychological classification of scientific knowledge such as are found in our traditional physics and chemistry courses."

I think Dr. Knox has hit the nail on the head, and I am proud to state that we also have something to offer along the line of his recommendations. Here, in Detroit, a twelve-year science program is now being developed. In the first six grades, the aim is to give the pupils experiences that lead to "major generalizations." In the junior high school, we teach general science. At this level generalizations are stated in more precise terms as scientific laws and principles. In the the senior high schools a two-way program is offered, one for the college-preparatory students and the other for the general group. The college-preparatory students take the standard science courses, including laboratory work. We recommend biology in the 10th grade, chemistry in the 11th, and physics in the 12th grade. The slower pupils may elect general biology in the 10th grade and descriptive chemistry and physics in the 11th or 12th grades.

In these descriptive courses we study the every-day applications of science. Pupils are not required to learn valences, to balance equations, nor to solve difficult mathematical problems. But please note that we have not confused our sciences by attempting to fuse them; chemistry and physics are offered as separate courses. It is my opinion, however, that in eliminating laboratory work for the non-college group, we have made a serious mistake. This group needs the concrete experiences that laboratory work gives, even more than do college-preparatory students. Slow-learning pupils, as a rule, do not read above the sixth grade level. They learn more readily by doing. Personal activity is essential to their growth.

Recognizing this need, we are now preparing some simple experiments in chemistry and physics for a course that might be called a workshop in science. This course should appeal to the ultimate consumer. In the laboratory, pupils are given an opportunity to test some materials commonly found in the home such as foods, drugs, clothing, and cleaning agents. They may also learn how to prepare ointments, hand lotions, hair dressings, and other cosmetics. This work is practical. However, the aims of a true science course in chemistry and physics are not neglected. Fundamental principles are applied and the scientific method developed by doing experiments that are interesting and useful rather than experiments that are designed merely to prove laws and theories.

In Detroit, we are also modifying our college preparatory courses. Committees have written and rewritten our laboratory manuals until we think they are good.

And when we adopt a modern chemistry textbook that fits in with our plan "to save the good and discard the bad," we shall be well fortified. Finally, as a cure for the schools that have been confused by the fused sciences, we recommend that you give our Detroit plan a trial. ●

Outdoor Leadership

Continued from Page Sixteen

by settlement camps, camps for diabetic children, a Rotary Camp for crippled children, Four H Camps, and other organizations. Most of the students were school teachers who carried the informal methods back to the school room. Some called it painless nature study. Among the outstanding leaders who graduated from the four summer course were Evelyn Hoke, Director of the Educational Museum at Ball Teachers College, Muncie, Indiana; Reverend George Link, Director of the Naturalist Programs in the State Parks of Illinois; and Elizabeth Keegan, Principal of an Elementary school in Cleveland. The northern Ohio constituency became so imbued that they formed an association which has field reunions every year. They feel that they are championing a cause and they are.

In the Fall of 1937, the present director was appointed to the staff of Massachusetts State College. The Nature Guide School was located in the Otter River State Forest near New Hampshire's Monadnock region. In the following year, due to the havoc of the hurricane, it was changed to Pine Tree Camp, the First National Girl Scout Training Camp at Plymouth, Massachusetts. That year the Pilgrim industries of spinning wool and flax, the gathering of herbs for medicine and dyes, and even brick-oven cooking were a part of the curriculum.

This brief history of the school has been presented as a background to another milestone which has just been reached. The Massachusetts Department of Conservation, through the cooperation and understanding of its new Commissioner, Raymond Kenney, has arranged for the school to have the use of the Arthur Wharton Swann State Forest Headquarters and a former hunting lodge. The Swann Forest is a 1,000 acre wild life area with plenty of deer and grouse. The region was recently stocked with wild turkey. It is in the heart of the 8,000 acre Beartown State Forest which is in the Berkshire Hills. Mount Wilcox, the highest elevation in the Forest, is just back of the school. This cooperative venture between the State College and the State Conservation Commission is suggestive of what may follow in other states. A part of the service to the public will be camp fire programs, nature trails, and guided trips. Graduates of the school are already demonstrating nature programs in the Pittsfield State Forest and in the Mt. Tom Reservation in the Connecticut Valley.

The Nature Guide School is fortunately located in the center of summer culture. It is easily accessible to the Lenox Bird Sanctuary, the Berkshire Museum, the Berkshire Playhouse, the Berkshire Festival, the Sunday afternoon Chamber Music Centers, and the internationally known Mohawk Trail. The courses* for the summer of 1942, besides leadership, will consist of flowering plants, gardening, and geology. If one considers this school in the forest and the many cultures available from the surrounding Berkshires, it could well be called the "University of the Out-of-Doors."

The National Defense program brings on a new angle for the school which is as old as the idea of democracy. The democratic way of life is best exemplified in the decentralized camp. By this is meant that children live in small outdoor groups of six or eight with two leaders. They really camp, making their own shelters. They practice conservation instead of taking it as another subject. Children of different races, creeds, classes, and opportunities, cooperating in the fundamentals of life, are living on the American plan. It is a big job to train competent, sympathetic leaders with the will and passion to carry on in such a program. The new biology teacher must, of course, know about the shuffling of the genes, such biological laws as that all men are not born with the same genes, and that it is unscientific when totalitarians pervert biology to prove racial superiority. He not only must know his biology but he must be able to practice it in the democratic way.

An important part of the Nature Guide School effort is to make certain that each student is schooled in outdoor democratic procedure. It may be due to the lack of such kind of enlightenment that Fifth Columns have been able to rise. The theory is that there are too many textbook-biology teachers who cannot practice or live what they teach. The human laboratory is surely the most important place that can be touched by biology, the study of life. The biology teacher who fears no evil from living in the open, who dares to use the great textbook of nature itself, who is sympathetic enough to be a brother to man in the wilds, and a forest companion to children with nature-hunger, will not only be stowing up treasures in his own heart but will hold a master key to a fuller and richer life. ●

*Due to war conditions and state finances these courses will not be available until 1942.

Stalactites that Blow Bubbles

A stalactite which blows bubbles has been reported at Lehman Caves, Nevada. The first clue to this unique feature came to the ranger's ears in a sound like that of water dripping rapidly into a pool. Search revealed that the source of the musical tinkle was the stalactite.

Apparently both water and air were coming down the channel in the center of the formation. This channel is about the size of a match, and as the air and water were emitted, the drops made a noise like bursting bubbles.